QL
401
M252

MALACOLOGICAL REVIEW

FIELD MUSEUM
OF
NATURAL HISTORY
JUL 30 1971

4

MALACOLOGICAL REVIEW

P. O. Box 801
Whitmore Lake, Michigan 48189
U. S. A.

* * * * *

Editor

J. B. BURCH

Associate Editor

C. M. PATTERSON

Participating Editors

A. INABA
R. NATARAJAN
W. F. PONDER
J. L. TOTTENHAM
S. K. WU

Editorial Associates

C. J. BAYNE
J. N. CATHER
E. S. DEMIAN
W. H. HEARD
Y. KONDO
C. T. LO
H. v. d. SCHALIE

Secretary

E. PERISHO KAWAMURA

Affiliated Editors

K. J. BOSS, *Johnsonia* and *Occasional Papers on Mollusks*
A. C. van BRUGGEN, *Basteria*
R. BURN, *Journal of the Malacological Society of Australia*
A. GISMANN, *Malacologia*
M. K. JACOBSON, *The American Malacological Union, Inc., Annual Reports*
M. A. KLAPPENBACH, *Comunicaciones de la Sociedad Malacológica del Uruguay*
R. KRAUSE, *Malakologische Abhandlungen, Staatliches Museum für Tierkunde in Dresden*
A. LA ROCQUE, *Sterkiana*
M. K. MIENIS, *Argamon*
K. NICOLAY, *La Conchiglia*
B. ROTH, *The Echo*
I. TAKI, *Venus*

© Copyright, *MALACOLOGICAL REVIEW*, 1971

All rights reserved. No part of this periodical may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording or by any information storage and retrieval system, without permission in writing from the Editor.

4

1971

MALACOLOGICAL REVIEW

4

1971

MALACOLOGICAL REVIEW

VOLUME 4, Number 1 1971

* * * * * *

CONTENTS

Research Articles

Mollusques lagunaires et recifaux de l'Ile de Raevavae (Australes, polynesie). B. SALVAT 1

The stepwise multiple regression method for selection variables for predicting the shell weight of freshwater mussels. B. G. ISOM 17

The hold-fast function of the preputial organ in *Helisoma* G. L. PACE 21

Brief Communications

The chromosome number of *Triboniophorus graeffei* from Australia. J. B. BURCH and C. M. PATTERSON 25

A karyotype technique using freshwater snail embryos. C. M. PATTERSON 27

Miscellanea

Abbreviated titles of scientific journals and place names to be used in literature citations in *Malacological Review* 29

Malacological Events

Société Française de Malacologie et Società Malacologica Italiana, Symposium 41
Western Society of Malacologists, Fourth Annual Meeting 41
Unitas Malacologica Europaea, Fourth European Malacological Congress 41
Symposium on Indian Mollusks and Malacology 42
The Conchological Society of Great Britain and Ireland, Programme of Meetings for the Remainder of 1971 42
Fifth Latin American Congress of Zoology 43
First International Congress of Systematic and Evolutionary Biology . . 43

(continued)

197292

CONTENTS (continued)

Malacological Societies' News

Second Australian Shell Collectors' Convention 44
Second Meeting of the Italian Malacological Society 45
The Israel Malacological Society, First Annual Symposium 45
Institute of Malacology, Tenth Annual Meeting 45

Announcements

University of Michigan - Fellowships in Malacology 46
Malacological Review - Volumes, issues and publication dates 46
New subscription price 46
Supplement to Volume 4, 1971 47
Supplement to Volume 5, 1972 47

Obituary: Franz Alfred Schilder 49

Contents of Malacological Periodicals, 1969 (cont.) 59
Author index for malacological periodicals, 1969 (cont.) 67

Contents of Malacological Periodicals, 1970 71
Author index for malacological periodicals, 1970 100

Publications 107

* * * * * *

GENERAL BOOKBINDING CO.
79 139CH 19 035 S
QUALITY CONTROL MARK
2049

Malacological Review, 1971, 4: 1-15

MOLLUSQUES LAGUNAIRES ET RECIFAUX DE L'ILE DE RAEVAVAE (AUSTRALES, POLYNESIE)[1]

Bernard Salvat

RESUME

No work has been published on mollusks of the Australs or the Tubuai Islands. Seven hundred kilometers south off Tahiti, the lagoon and barrier reef of the volcanic island Raevavae have been prospected malacologically: the intertidal area, the fringing reef and the lagoon qualitatively (faunal lists and bionomics), and the outer barrier reef by quantitative transects.

The same malacological fauna was encountered as previously in the Tuamotu archipelago. The Raevavae fauna was poorer in the lagoon biotopes, except for the intertidal zone. In comparison to the results at Fangataufa (Tuamotu atoll) and Gambier (a high volcanic island, as Raevavae) some distinctive features occurred for reefs of the barrier reef (morphologically identical to an atoll), qualitatively (lists of species) and quantitatively (density of population). A main characteristic of volcanic islands which is opposite to that of atolls is the gentle outer slope following the coralline edge of the barrier reef (instead of having an outer slope at 45°); this characteristic has important influence on mollusk distribution.

L'archipel des Australes (encore appelé Tubuaï) comprend sept îles orientées selon un axe Nord Ouest - Sud Est, de près de 1400 km, allant de Maria à l'îlot de Bass en passant par Rimatara, Rurutu, Tubuaï, Raevavae et Rapa. L'île de Raevavae (Fig. 1), sensiblement au milieu de l'archipel, est à près de 700 km au sud de Tahiti et à 1300 km à l'est des Gambier. Six degrés de latitude séparent Tahiti de Raevavae. Raevavae et les Gambier sont par 23-24° de latitude sud, la première île légèrement au sud du tropique du Capricorne, et le second ensemble légèrement au nord. Les îles Australes sont les témoins émergés d'une chaîne de montagnes selon une ride qui est isolée par des fonds supérieurs à 4000 mètres des rides Tuamotu et Société. L'île de Rapa par 27° de latitude sud ne comporte pas de récif barrière mais seulement quelques récifs frangeants. Raevavae est l'île haute la plus au sud de la Polynésie française possédant encore d'importantes formations coralliennes, dont un récif barrière bien développé. Au cours des prospections du 28 avril 1968 la température de l'eau était de 23° sur le récif extérieur et de 24°5 dans le lagon.

Les îles Australes ou Tubuai ont été très rarement visitées par des naturalistes et récolteurs. C'est ce que remarquait Schilder (1965) dans son bilan de la répartition géographique des *Cypraea* et c'est la raison pour laquelle il demandait (1966) des informations faunistiques sur ces îles. Rehder (1966) devait répondre à cette demande en indiquant la présence aux îles Tubuai de plusieurs espèces de *Cypraea* ce qui portait leur nombre à 17. Ce sont à notre connaissance, les seuls travaux malacologiques sur les îles Australes. Rappelons que dans "Mollusques Testacés marins des Etablissements français de l'Océanie", de Dautzenberg & Bouge (1933), il n'est question que de récoltes effectuées aux Marquises, Société, Tuamotu et Gambier. Les présentes recherches nous semblent donc venir à temps, du point de vue faunistique, biogéographique et écologique. Pour une bibliographie malacologique à l'échelle de la Polynésie française nous renvoyons à une publication antérieure: Salvat (1967).

---

[1]Recherches réalisées dans le cadre de conventions entre la Direction des Centres d'Expérimentations Nucléaires, Service Mixte de Contrôle Biologique et le Museum National d'Histoire Naturelle, n° 68-04-023 du 2.02.68 - Publication réf. S. 14 (Mission V, 1968).

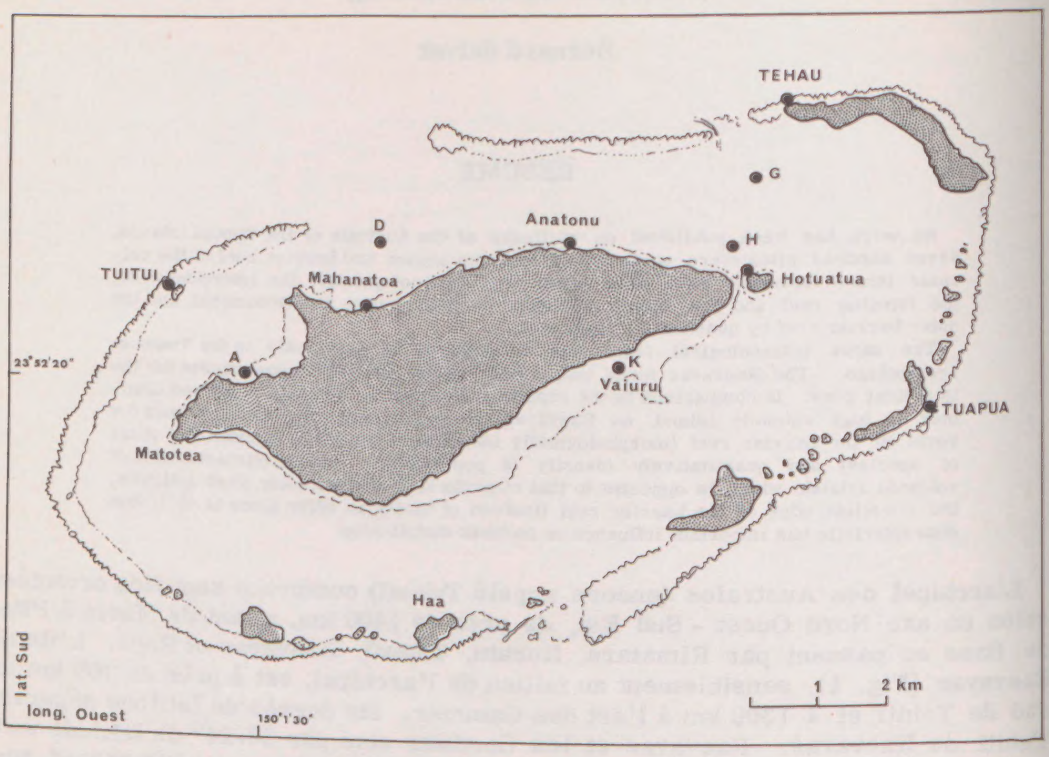


FIG. 1. L'île de RAEVAVAE (Archipel des Australes), localités de prospection.

Cette île haute de forme allongée, et dont le sommet culmine à 480 mètres d'altitude, atteint 9 km de longueur. Elle est entourée d'un récif barrière presque continu, mis à part trois passes, une principale au nord et deux secondaires, au sud et au nord est, qui ne sont praticables que par de très légères embarcations. Le lagon est très peu profond mais assez large; le récif barrière dessine un ovale dont le grand diamètre est de 14,4 km. Les récifs frangeants en bordure de l'île sont bien développés.

A la différence de l'atoll de Fangataufa, ou des îles Gambier précédemment étudiées, également dans la zone tropicale, le climat de Raevavae présente des saisons plus nettement marquées. Les alizés dominants soufflent de l'est. Le récif barrière comprend quelques motus émergés avec végétation surtout dans ses parties orientale et méridionale. Les récifs d'îlots qui furent quantitativement prospectés en avril 1968 sont ceux de TUAPUA et de TUITUI (Fig. 1) alors que seul un relevé qualitatif des espèces malacologiques a été effectué à TEHAU.

Les formations coralliennes sont généralement classées selon quatre types principaux: les récifs frangeants, les récifs barrières, les récifs immergés et les atolls. Cette classification ne correspond pas aux grandes entités géomorphologiques telles qu'on les rencontre dans les régions tropicales et subtropicales où prospèrent les Madréporaires. Ces grandes entités sont au nombre de trois: îles hautes volcaniques (ou bordures continentales), récifs immergés et atolls.

Les îles hautes volcaniques présentent habituellement un récif frangeant et un récif barrière; le premier borde directement le rivage alors que le second détermine entre lui et le rivage un lagon plus ou moins profond et plus ou moins large. Ces récifs barrières peuvent présenter différents aspects. Ils sont généralement immergés et leur sommet est à quelques décimètres du plan d'eau de basse mer, parfois même émergeant à marée basse, tel est le cas de la plus grande partie du Grand Récif de la côte Ouest de la Nouvelle Calédonie comme du Récif barrière de Tahiti. Le récif barrière peut présenter deux structures particulières: la première est celle d'un îlot émergé couvert de végétation, comme les nombreux îlots du Grand Récif de Nouvelle Calédonie, dûs à une accumulation de matériaux bioclastiques, ou comme les "motu" des îles de la Société (Bora Bora) ou des Gambier. La seconde structure particulière est la passe, ou échancrure dans le récif, dont le seuil est à quelques mètres au-dessous du niveau de basse mer mais suffisamment profond pour permettre, d'une part, des échanges hydrodynamiques non négligeables entre l'océan et le lagon, et d'autre part, l'entrée de bateaux dans le lagon.

Par récifs immergés on entend généralement les édifices coralliens isolés en plein océan et dont la plateforme se trouve à quelques mètres au dessous du niveau de la mer à marée basse. Ces structures sont habituellement marquées "Récifs" ou "Brisants" sur les cartes marines. Les actuels atolls des Tuamotu furent de - 8000 à - 3000 ans des récifs immergés, période au cours de laquelle le niveau de la mer montait plus ou moins régulièrement avant de redescendre il y a 3000 ans, de trois mètres environ, pour atteindre le niveau actuel de la mer.

Les atolls, enfin, sont des formations émergées de constitution exclusivement biogène. Ces édifices comprennent généralement un anneau émergé (éventuellement couvert de végétation) délimitant en son centre un lagon. La bordure émergée peut être continue ou discontinue (motu) et les échancrures submergées sont de trois types principaux: passe, comme pour les récifs barrières - platier immergé, c'est à dire large partie de la bordure à fleur d'eau à marée basse - chenaux de communication entre l'océan et le lagon, ou hoa en Polynésie. La bordure émergée de l'atoll donne sur l'océan par le récif extérieur, et sur le lagon par une plage ou un récif frangeant; dans le lagon les pinacles et les pâtes coralliens s'élèvent du fond sableux.

La structure qui nous intéresse ici concerne les récifs extérieurs et, comme l'ont souligné Odum & Odum (1955), il convient de distinguer les "islands reefs" (récifs d'îlots) et les "inter island reef" (récif ou platier immergé). Les récifs d'îlots qui reçoivent directement la houle de l'océan se rencontrent sur les récifs barrières d'îles hautes volcaniques d'une part, et sur les atolls d'autre part, comme nous venons de le voir.

Ces récifs d'îlots ont été étudiés en Polynésie française dans le cadre de conventions entre la Direction des Centres d'Expérimentations Nucléaires, Service Mixte de Contrôle Biologique et le Muséum National d'Histoire Naturelle. Deux travaux ont déjà été publiés à ce sujet sur la bionomie et la richesse (abondances, densités, dominances) de la faune malacologique des récifs extérieurs. Le premier à partir de prospections réalisées dans l'atoll de Fangataufa, Archipel des Tuamotu (Salvat, 1969, 1970a); le second à la suite des études effectuées sur les récifs d'îlots du Grand Récif Barrière entourant les Gambier (Salvat, 1970b), les îles volcaniques au sud est des Tuamotu. Le présent travail concerne l'île haute de Raevavae dans l'Archipel des Australes. Tour ces récifs d'îlots sont analogues du point de vue géomorphologique de sorte que leurs peuplements peuvent être comparés.

Les techniques quantitatives de prospection de ces radiales ont déjà été exposées en détail (Salvat, 1970a) pour qu'il soit suffisant de rappeler que les radiales sont composées sur toute la largeur du récif de stations contiguës de 6 m^2 dans lesquelles toute la faune malacologique est récoltée, déterminée, comptée et pesée (poids frais brut et calcul du poids frais décalcifié). Les résultats pondéraux qui suivent sont exprimés en poids frais décalcifié. Face à la houle océanique chaque récif extérieur peut-être divisé en cinq zones essentielles sur lesquelles nous ne reviendrons pas (voir Salvat 1970a): pente externe, crête algale qu'il est préférable de nommer zone frontale, platier, zone supérieure, îlot avec sa végétation. Dans le lagon les prospections des substrats immergés ont été réalisées en scaphandre autonome ou en apnée. Les Echinodermes ont été déterminés par M. Cherbonnier, Sous-Directeur au Museum, que je remercie vivement pour la rapidité avec laquelle il a determiné ces echantillons à mon intention.

I. LA BORDURE DE L'ILE VOLCANIQUE: INTERTIDAL et RECIF FRANGEANT, LE LAGON

Un tour de l'île a permis de constater l'opposition entre la bordure septentrionale (sous le vent), dont nous avons prospecté plusieurs points (voir la carte), et la bordure méridionale, beaucoup plus homogène, sur laquelle une seule station de prospection a été choisie. Toute l'île est bordée à sa périphérie par un récif frangeant, plus ou moins large, qui s'interrompt brusquement du côté lagon et au pied duquel débute le fond sableux par 2 à 3 mètres de profondeur. Les échancrures dans ce récif frangeant sont peu nombreuses. Alors que la côte nord de l'île est bordée par des plages sableuses, toujours étroites cependant, interrompues par des zones rocheuses à la hauteur de chaque avancée de l'île dans le lagon, la côte sud ne comprend pratiquement pas de dépôts sableux intertidaux. Le récif frangeant est toujours très près de la côte sur la bordure nord, et délimite entre lui et la plage de sable une zone de quelques dizaines de mètres de largeur tout au plus, d'une profondeur variable mais toujours inférieure à deux mètres et encombrée de blocs coralliens plus ou moins vivants, mais couverts de végétation; ceux-ci sont de plus en plus nombreux en s'éloignant du rivage et forment un récif frangeant difficile à franchir à marée basse, car il est au ras de l'eau, et sur lequel prédominent largement les Sargasses et les Turbinaria. En revanche, sur la rive méridionale de l'île la bordure externe du récif frangeant est très éloignée du rivage. D'autre part entre le rivage et cette zone externe du frangeant se situe une zone correspondant soit à un platier, à fleur d'eau à marée basse, soit à un substrat meuble vasard sous quelques décimètres d'eau. La Fig. 2 illustre cette opposition de structure entre les bordures méridionale et septentrionale de Raevavae.

A. La bordure septentrionale

Les sédiments meubles intertidaux n'abritent aucun Mollusque endogé, pas plus que les étendues sableuses sous quelques décimètres d'eau, entre la plage et le récif frangeant, autant qu'il nous fut donné de le constater. Cependant au milieu de blocs rocheux, les retenues sableuses sont quelquefois habitées par plusieurs espèces de bivalves d'assez grande taille comme: *Gafrarium pectinatum*, *Tellina rugosa*, *T. scobinata*, et plus rarement, *Venus reticulata*, *Asaphis deflorata*, *Codakia divergens*.

Sur le substrat rocheux intertidal deux espèces, à un niveau élevé, *Nerita plicata* et *N. morio* sont souvent aussi abondantes l'une que l'autre alors que *N. albicilla* est beaucoup plus rare. En certains points, les *Siphonaria* sp. sont abondantes (Wharf de RAIURUA, ANATONU). Au niveau de basse mer et sous quelques décimètres d'eau la faune malacologique est plus variée en particulier à HOTUATUA, avec des Buccinidae: *Cantharus fumosus* et *Engina alveolata*, des Conidae: *Conus ebraeus* et *C. coronatus*, des Cypraeidae: *Cypraea*

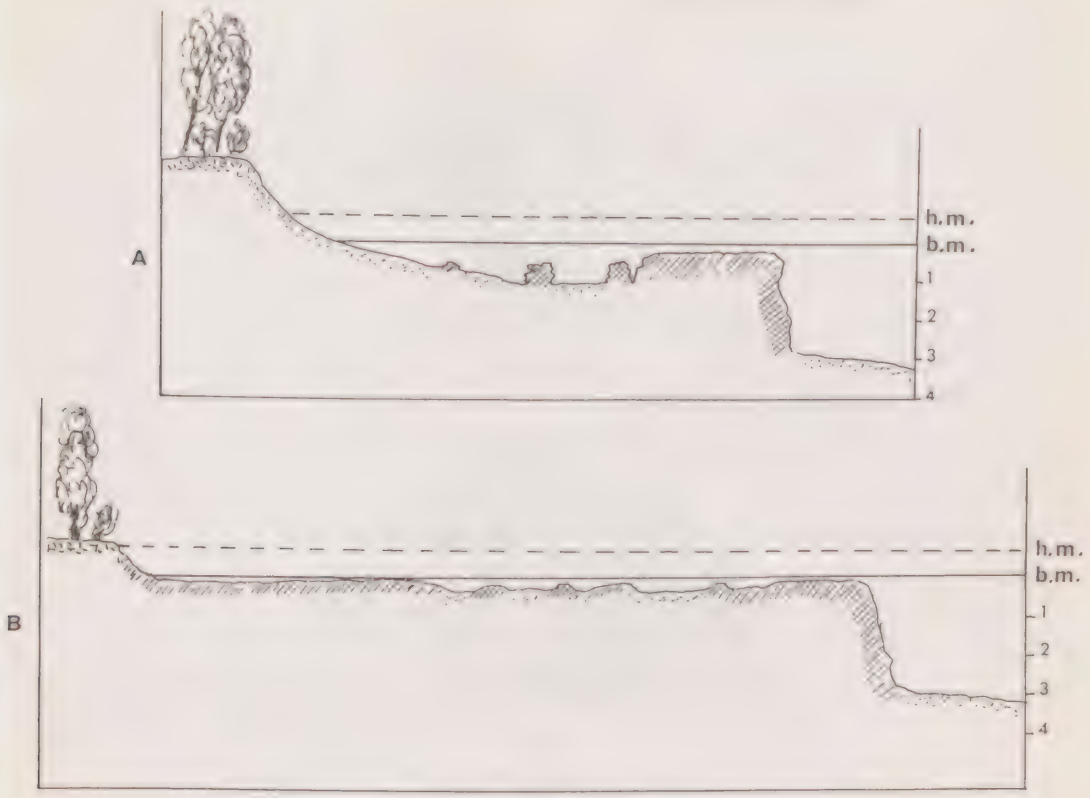


FIG. 2. Profil topographique comparatif des bordures lagunaires septentrionale (A) et méridionale (B) de l'île - h.m. et b.m., niveaux de haute et basse mer - profondeurs en mètres.

capulserpentis et *C. obvelata*, des Cerithiidae: *Cerithium columna*, *C. sinensis*, *C. nesioticum* et *C. piperitum*, des Cymatiidae: *Cymatium muricinum*, des Muricidae: *Morula granulata*, des Nassariidae: *Nassarius concinna* et quelques bivalves sessiles: *Chama imbricata*, *Tridacna maxima* mais surtout *Modiolus auriculatus* et *Isognomon isognomum*. La plupart de ces espèces sont présentes entre le niveau de basse mer et le récif frangeant, c'est-à-dire sous quelques décimètres à un ou deux mètres d'eau maximum, et sur les quelques blocs volcaniques ou coralliens plus ou moins recouverts de Sargasses. On note également la présence d' *Octopus* sp. Le récif frangeant, réalisant une haute barrière presque continue, dont le sommet émerge au cours des basses mers de vives eaux, est recouvert à près de 90% par des Sargasses et des Turbinaria. Cette bordure du récif frangeant n'est plus habitée que par quelques espèces déjà rencontrées: *Isognomon isognomum*, *Modiolus auriculatus*, *Cerithium nesioticum*, *Conus ebraeus*, puis moins abondant: *Drupa ricinus*, *D. morum* et *Vermetus maximus*.

Très près du rivage le substrat est parfois constitué par une dalle lisse avec de petites cuvettes (RAIURUA) et les *Isognomon isognomum* peuvent alors être abondants, de 20 à 25 au mètre carré.

Parmi les autres groupes faunistiques, il convient de citer la présence et parfois l'abondance de l'Holothurie *Halodeima atra* sur le sédiment, en arrière du récif frangeant.

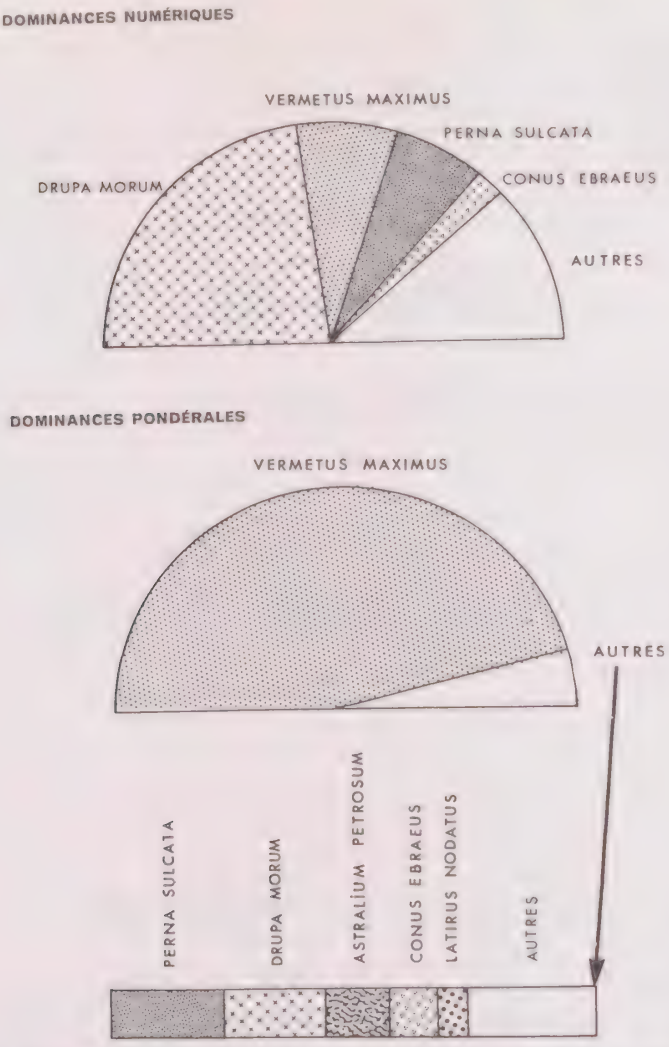


FIG. 3. Récif de TUITUI: dominances numériques et pondérales des différentes espèces malacologiques.

B. La bordure méridionale

En arrière du récif frangeant, dont le sommet est recouvert de Sargasses abritant la même faune que précédemment, le substrat est constitué par un sédiment meuble vasard, réduit en profondeur, et sur lequel sont échoués quelques petits blocs détritiques; des touffes de Sargasses sont accrochées çà et là. Avec l'Holothurie *Halodeima atra*, très abondante, les seuls Mollusques récoltés sont *Cerithium lineatum* et *Gafrarium pectinatum* dans le sédiment sous quarante centimètres d'eau maximum. En bordure du rivage le substrat est composé d'éléments détritiques plus ou moins consolidés et formant une sorte de platier recouvert par une pellicule vaseuse. On y rencontre quelques *Modiolus auriculatus* mais surtout *Isognomon isognomum* (jusqu'à 60 individus au m^2) et des *Siphonaria*, puis plus haut, *Nerita plicata* au pied de la végétation.

C. Le Lagon

La briéveté de notre séjour ne nous a pas permis de prospecter de nombreuses stations dans le lagon peu profond de Raevavae.

La plus grande profondeur, une quinzaine de mètres tout au plus, se situe dans la partie nord ouest du lagon, en face de la passe principale. Dans cette région, par douze mètres de fond, (point D sur la Fig. 1) il s'agit d'un sédiment relativement grossier, sans fraction fine, avec des grands ripple marks (un mètre de long et douze centimètre de hauteur). Aucun Mollusque endogé n'a été récolté et les pâtés coralliens, morts à 80% et recouverts à 70% par les algues, n'abritent dans les anfractuosités que deux petits échinides. Quelques *Chama imbricata* sont les seuls représentants malacologiques et quelques colonies d'Alcyonaires sont également présentes. Comparativement à la faune des lagons d'atolls des Tuamotu on est saisi par la pauvreté de la faune en général; absence de *Tridacna*, d'*Arca*, de *Pinctada*, de *Vermetus*. *Halodeima atra* est elle aussi absente sur ce fond de 12 mètres d'eau, alors qu au point K, sous trois mètres d'eau, elle est très abondanto. A cette station les algues recouvrent presque totalement le substrat dur sur lequel on peut récolter *Cypraea moneta*, *Conus ebraeus* et *Astralium petrosum;* un test de *Conus pulicarius* a également été récolté. A TEHAU et à TUAPUA, côté lagon, il y a d'importants peuplements de *Cardium fragum* dont les valves sont rejetées sur les plages. A TUITUI, côté lagon, la zone intertidale correspond à une accumulation de blocs très grossiers (par endroit analogue à des plages de galets). Au niveau supérieur des débris d'algues (notamment Sargasses) s'échouent en grande quantité. C'est au niveau de cette laisse de haute mer moyenne qu'abonde *Nerita plicata*. *Littorina coccinea* a été récoltée sur des troncs d'arbres morts au dessus de l'eau.

II. LE RECIF EXTERIEUR

A. Etude du récif sous le vent: Tuitui et Tehau (Fig. 5, 6)

Le récif de Tuitui s'étire sur une centaine de mètres entre la partie externe de la zone frontale et la plage de sable qui borde l'îlot. En aval de la zone frontale, une large plateforme sous-marine correspond à une pente externe très douce qui n'a rien de commun avec la pente externe des atolls, généralement beaucoup plus forte. Le platier de Tuitui présente un relief irrégulier et assez accidenté dont le substrat est une dalle corallienne en voie d'érosion, en pente légère vers l'extérieur et recouverte par 5 à 10 dm d'eau en moyenne. Certaines parties du platier, en cuvette, sont profondes de 1,20 m alors que des blocs témoins émergent par endroits.

La zone frontale, qu'il ne conviendrait pas de nommer ici crête algale, car les algues calcaires y sont peu abondantes, est basse. Sur la dalle recouverte par un mètre d'eau à marée basse des cailloutis se sont accumulés dans des cuvettes et avec quelques madrépores (genres *Montipora*, *Porites*, *Acropora*) il y a par places quelques importants recouvrements en Caulerpes et Cyanophycées. Cette zone frontale est, quant à sa faune malacologique, dominée par trois familles de Gastropodes: les Muricidae, surtout *Drupa morum* jusqu'à 5 individus au mètre carré, puis *D. ricinus*, *D. horrida* et *D. elata*, les Conidae avec *Conus miliaris*, *C. chaldeus*, *C. ebraeus* et *C. flavidus* et les Vermetidae avec *Vermetus maximus*. Trois autres espèces ont été également récoltées: *Astralium petrosum*, *Peristernia nassatula* et *Cerithium sinensis*.

Le platier fait suite à la zone frontale sans qu'il soit possible de bien délimiter les deux zones. La dalle corallienne lisse et nue n'est cependant pas plate mais

présente cuvettes et mamelons aux dimensions décimètriques: il n'y a pas de gros blocs détritiques échoués sur le platier. Les colonies madréporiques sont rares. La partie interne du platier est caractérisée aux stations 24 et 29-30 par deux alignements émergés, parallèles à la ligne de rivage, et correspondant au conglomérat récifal ancien qui date de 3000 ans avant l'abaissement du niveau de la mer. Ces alignements en voie d'érosion sont séparés par une partie du platier profonde de 1,20 m, et en amont de la station 30 se situe une dernière retenue d'eau (même à marée basse) de 6 mètres de largeur, avant la plage de sable.

Sur le platier on rencontre une faune homogène jusqu'à la station 28. Les espèces présentes dans la zone frontale colonisent également le platier, à l'exception de *Drupa horrida*. Les densités de peuplement de *D. morum* sont plus importantes à certaines stations du milieu du platier-jusqu'à 45 individus pour 6 m^2 - que sur la zone frontale. Aux espèces de la zone frontale s'ajoutent *Latirus nodatus* et *Vermetus maximus* - assez abondantes -, *Isognomon sulcata* - abondante entre les deux alignements émergés de la partie interne du platier -, et les espèces suivantes représentées par quelques individus seulement: *Cantharus undosus*, *Strigatella litterata*, *Cypraea moneta*, *Vanikoro petitiana*, *Strombus gibberulus*, *Cerithium sinensis*, *C. columna*, *C. nesioticum*, *C. linealum*, *Columbella versicolor*, pour les Gastropodes, et *Modiolus auriculatus*, *Pinctada maculata*, *Gafrarium pectinatum*, *Venus reticulata*, *Trapezium oblongum* pour les Lamellibranches. Les derniers Mollusques se rencontrent à la station 31: *Nerita plicata*, *Isognomon sulcata* et un seul individu de *Ricinula cancellata*.

Du point de vue qualitatif on notera pour la zone frontale, comparativement aux résultats obtenus sur d'autres récifs extérieurs (Salvat, 1970a et b) l'absence de *Patella stellaeformis*, et la rareté de *Turbo setosus* - présente malgré tout en dehors de notre radiale -, espèces caractéristiques de récifs battus. On notera de même l'absence sur le platier de *Conus nanus* et de *C. sponsalis*, ainsi que de *Chama imbricata*, espèce pourtant abondante sur les platiers extérieurs abrités de Fangataufa ou du récif barrière des Gambier. On notera enfin l'absence en haut de plage de *Tectarius grandinatus* et de *Littorina coccinea*, absence qui pourrait s'expliquer par l'inexistence de substrat favorable à ces espèces puisque en amont des *Nerita plicata*, niveau où vivent généralement *Tectarius* et *Littorina*, il y a une plage de sable.

En revanche, on remarquera la présence de quelques espèces qu'il ne nous fut pas donné de récolter dans les radiales quantitatives de Fangataufa ou des Gambier: *Astralium petrosum*, *Peristernia nassatula* et *Latirus nodatus*, pour nous en tenir aux trois principales. Au total, le nombre d'espèces est assez élevé (31) avec plusieurs Lamellibranches, fait qui confirme une observation déjà réalisée à Fangataufa: en mode abrité les platiers sont plus riches en espèces car les conditions hydrodynamiques plus calmes permettent l'installation d'espèces rencontrées habituellement dans les lagons.

Parmi les tests de Gastropodes habités par des Pagures, on a noté la présence de *Trochus calcaratus*, espèce que nous n'avons pas récolté vivante sur le récif. On doit également signaler la présence de *Lambis truncata* sur la pente externe, au delà de la zone frontale, et d'*Hipponyx pilosus* (dont nous n'avons pas tenu compte dans nos relevés) dont de nombreux individus sont fixés sur *Isognomon sulcata*.

En dehors des Mollusques on rencontre quelques échinodermes peu nombreux en espèces comme en nombre d'individus: *Microthele difficilis* (5 individus dans la radiale) et un individu de chacune des espèces: *Halodeima hilla* et *Holothuria pervicax*.

Du point de vue quantitatif, en nombre d'individus, les 192 mètres carrés de récifs prospectés (96 m perpendiculairement au rivage et 2 m de large) ont

amené la récolte de 647 individus pour 31 espèces. Parmi ces espèces, 14 ne sont représentées que par un ou deux individus. Parmi les 17 restantes les mieux représentées sont *Drupa morum* (301 individus), *Vermetus maximus* (101), *Isognomon sulcata* (86) et *Conus ebraeus* (27).

Du point de vue pondéral les 647 Mollusques donnent un poids frais décalcifié de 3280 g. mais *Vermetus maximus* représente 92,2% de ce total. *Isognomon sulcata* et *Drupa morum* viennent en deuxième et troisième position avec 1,9 et 1,6%.

Les abondances relatives, ou dominances, quant aux nombres d'individus d'une part et aux biomasses décalcifiées d'autre part, sont représentées par les diagrammes de la Fig. 3.

Le récif de TEHAU, dans son extrémité occidentale, en bordure d'une passe secondaire au nord est de l'île de Raevavae, a été étudié plus sommairement puisqu'un relevé seulement qualitatif des peuplements y fut effectué. Assez semblable au récif de Tuitui, le récif de Tehau présente également une zone frontale basse et un platier qui émerge dans sa partie interne à marée basse. Ce récif est dominé du point de vue faunistique par deux holothuries, *Halodeima atra* et *Actinopyga serratidens*, par *Vermetus maximus* très abondant partout sur la dalle morte, mais surtout par deux gastropodes au milieu du platier: *Drupa horrida* et *Patella stellaeformis*. Ces deux dernières espèces adhèrent très fortement au substrat émergeant à basse mer; elles sont généralement caractéristiques de la zone frontale et leur présence sur ce récif et à ce niveau n'est probablement pas sans rapport avec la proximité de la passe secondaire ce qui doit déterminer un mode plus battu qu'à Tuitui. Les autres espèces récoltées sont les suivantes: *Conus ebraeus*, *C.chaldeus*, *C. flavidus*, *Drupa ricinus*, *D. grossularia*, *D. fiscella*, *Peristernia nassatula*, *Strigatella litterata*, *Latirus nodatus*, *Cymatium chlorostomum*, *Arca plicata*, *Chama asperella*, *Codakia tigerina* et *C. divergens*. Deux test de *Natica marochiensis* et de *Nerita polita* ont egalement été récoltés, de même qu'un individu vivant du genre *Umbraculum*.

B. Etude du récif au vent: Tuapua

Au sud de l'île, le récif de Tuapua se situe sur une bordure du récif barrière qui reçoit la houle océanique la plus forte, face aux vents dominants. Mais ce récif au vent est en fait peu différent géomorphologiquement du récif sous le vent étudié précédemment. La zone frontale est basse et peu développée; on passe insensiblement de celle-ci à la pente externe, extrêmement douce, ou au platier, comme à Tuitui. Le platier de Tuapua est dans son ensemble un récif mort où sur une dalle lisse et nue les colonies madréporiques sont peu nombreuses, dans la partie externe, et totalement absentes dans la partie interne. Le platier n'est submergé que par quelques décimètres d'eau á mareé basse. Un feutrage algal de quelques millimètres d'épaisseur tapisse le plus souvent la dalle et quelques petits blocs détritiques sont échoués sur le platier dans sa partie interne. Enfin, à 108 m du début de la radiale (dans la zone frontale) la dalle du platier est recouverte à partir de la station 36 par un sédiment très mal classé, plage qui mène à la végétation.

Dans la zone frontale on rencontre essentiellement des Muricidae: *Drupa ricinus*, *D. morum* et *D. horrida*, des Conidae: *Conus ebraeus*, *C. chaldeus*, et *Conus miliaris* puis *Cypraea caputserpentis*, et surtout *Vermetus maximus*, espèce dominante. A l'exception de *Drupa ricinus* et de *Cypraea caputserpentis*, ces espèces se retrouvent sur le platier, en moins grande abondance pour *Drupa morum* et en plus grande abondance pour *Drupa horrida*, et en compagnie d'espè-

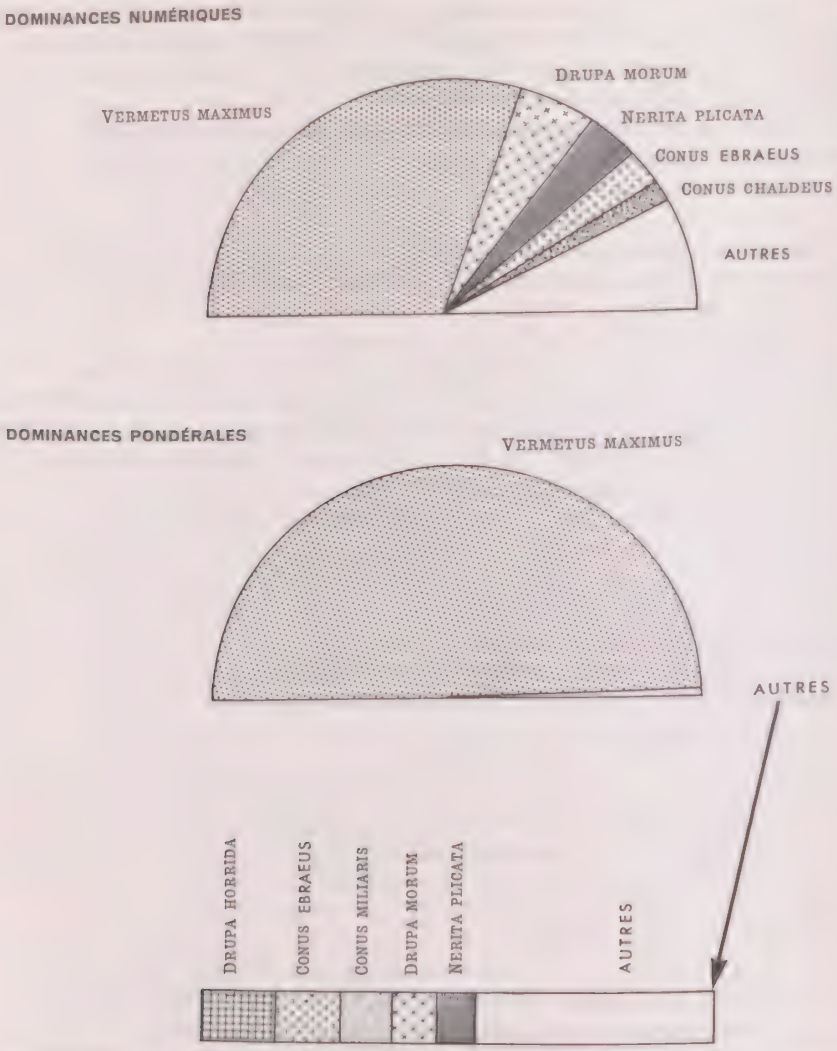


FIG. 4. Récif de TUAPUA: dominances numériques et pondérales des différentes espèces malacologiques.

ces qui ne sont représentées chacune que par quelques individus: *Strigatella litterata*, *Peristernia nassatula*, *Drupa elata*, *D. grossularia*, *Morula granulata*, *Strombus gibberulus*, *S. mutabilis*, *Cerithium nesioticum*, *Conus flavidus*, *C. lividus*, *C. coronatus*, *Bursa bufonia*, *Pyramidella propinqua*, *Isognomon sulcata*, *Pinctada maculata*, *Gafrarium pectinatum*, *Chama imbricata*, *Hipponyx pilosus* et *Mytilus* sp. Les deux dernières stations du platier, juste avant la plage de sable, sont colonisées par *Nerita plicata* et par *Nerita morio* dont un seul individu a été récolté.

Comme faune associée il convient de citer des coraux (genres *Millepora* et *Pocillopora*) bien représentés dans la zone frontale, et des algues *Pocockiella* et *Caulerpa*. Une Holothurie est particulièrement abondante sur tout le récif *Actinopyga serratidens* dont 210 individus ont été récoltés sur les 222 m^2 de la rádiale (37 stations contigües de 3 m de long sur 2 m de large). Une autre Holothurie est bien abondante: *Microthele difficilis*, et plus rares: *Holothuria pervicax* et *Holothuria leucospilota*. La présence de rares colonies de *Scleroderma* a

FIG. 5. Récif de TUITUI à mi-marée. Les vagues déferlent sur la zone frontale - le platier, où se trouvent les récolteurs, est submergé - au premier plan plage de sable et conglomérat ancien.

FIG. 6. Récif de TUAPUA. Entre la zone frontale, où se brisent les vagues de l'océan, et la zone supérieure constituée par une haute accumulation de blocs détritiques, le platier n'est submergé que par quelques décimètres d'eau.

été également notée - les Anomoures habitant des coquilles de *Drupa* et de *Conus* sont peu nombreux.

Du point de vue qualitatif les mêmes remarques peuvent être faites qu'à propos du récif de Tuitui. L'absence d'espèces de mode battu dans la zone frontale

(*Turbo, Patella*) démontre la faiblesse des actions hydrodynamiques, bien que le récif soit au vent, très certainement en raison de la longue zone externe en pente très douce située en avant de la zone frontale et qui brise la houle avant qu'elle n'arrive sur le récif. Un seul *Chama imbricata* a été récolté sur le platier de Tuapua de sorte qu'il est logique de souligner leur extrême rareté sur un récif qui leur offre, apparemment, les meilleures conditions. L'absence de *Conus sponsalis* (sauf 1 individu) et de *Conus nanus* sur le platier, de *Tectarius grandinatus* et de *Littorina coccinea* dans la zone supérieure doit être également soulignée comparativement à leur abondance à Fangataufa. Le récif de Tuapua est aussi riche en espèces que celui de Tuitui: 30 espèces pour le premier contre 31 pour le second, dont respectivement, 17 et 18 espèces représentées par plus de 2 individus.

Du point de vue quantitatif les densités maximales de quelques espèces méritent d'être indiquées pour des stations de 6 m^2 - *Drupa morum:* 33 individus - *Nerita plicata;* 39 - et l'extraordinaire concentration en *Vermetus maximus:* 160 individus, soit 27 individus/m^2. Dans les 222 m^2 de récifs prospectés, 1042 Mollusques ont été récoltés dont 628 *Vermetus maximus* (60%), 108 *Drupa morum* (10%) et 75 *Nerita plicata* (7%).

Déjà dominante numériquement, *Vermetus maximus* domine pondéralement avec 18.840 g de biomasse décalcifée pour un total de 18.996 g dans la radiale. Les diagrammes de la Fig. 4 donnent les dominances des principales espèces, en nombre d'individus et en biomasse, pour le récif de Tuapua.

C. Conclusion

La prospection quantitative des deux radiales, l'une au vent (Tuapua) et l'autre sous le vent (Tuitui) a amené la récolte de 43 espèces de Mollusques. Sur les 31 espèces recensées à Tuitui, 17 sont représentées par 3 individus au moins; pour Tuapua les nombres correspondant sont 30 et 18. Parmi les 43 espèces cataloguées, 18 sont communes aux deux récifs, mais les méthodes de prospections excluent les espèces rares à très faible densité de peuplement.

Nous avons vu qu'en fait aucun des récifs n'est véritablement battu avec des conditions hydrodynamiques aussi fortes que celles qui peuvent être rencontrées sur les récifs extérieurs d'atoll. Nous avions déjà signalé ce phénomène dans l'étude du récif extérieur du récif barrière des Gambier et l'explication donnée est également valable ici: la pente externe en avant de la zone frontale est en pente douce (alors qu'elle est généralement à 45° dans le cas des atols) ce qui a pour effet de réduire la force de la houle océanique.

Du point de vue qualitatif quelques remarques doivent être faites sur certaines espèces. Dans la zone frontale l'absence de *Turbo setosus* dans nos radiales traduit bien sa rareté à Raevavae mais, comme nous l'avons signalé à propos du récif de Tuitui, l'espèce est cependant présente. Une autre espèce est rare sur les récifs extérieurs de Raevavae: *Littorina coccinea*. Mais surtout quelques espèces communes à Fangataufa ou aux Gambier n'existent plus à Raevavae: *Conus nanus* sur le platier, *Tectarius grandinatus* dans la zone supérieure. Un seul individu de *Conus sponsalis* a été récolté sur le récif extérieur; sans être totalement absente, l'espèce peut y être considérée comme très rare surtout comparativement à son abondance à Fangataufa et aux Gambier. En revanche, plusieurs espèces font leur apparition sur les récifs extérieurs de Raevavae alors qu'il ne nous fut jamais donné de les récolter dans les radiales de Fangataufa ou des Gambier: *Drupa elata, Cantharus undosus, Latirus nodatus, Peristernia nassatula* et *Nerita morio*.

Du point de vue quantitatif, les densités moyennes de peuplement (3,8 et 4,7 individus au m^2 à Tuitui et Tuapua) sont du même ordre de grandeur que celles obtenues à Fangataufa ou aux Gambier, de même que la biomasse moyenne (1,3 et 0,7 g/m^2 à Tuitui et Tuapua) si l'on exclut *Vermetus maximus*. Si l'on compte cette dernière espèce, compte tenu des très grandes densités relevées à Tuapua en particulier, la biomasse moyenne est la plus importante que nous ayons relevée: 85 g/m^2.

En conclusion, la faune malacologique du récif barrière de l'île de Raevavae dans l'archipel des Australes, à 700 km au sud de Tahiti (6° de latitude plus au sud) et à 1300 km à l'est des Gambier (à 13° de longitude) est analogue à la faune malacologique des Tuamotu et des Gambier. Pour les récifs extérieurs d'îlots, présentement étudiés, la richesse, en nombre d'espèces et en densités de peuplement (nombre d'individus et biomasses) est du même ordre de grandeur. Deux faits doivent être soulignés: (1) Du point de vue biogéographique certaines espèces, communes sur les récifs extérieurs des atolls des Tuamotu ou du récif barrière des Gambier, se trouvent éliminées à Raevavae (*Conus nanus*, *Tectarius grandinatus*). La différence de latitude est inférieure à 1° entre les Gambier et Raevavae mais les conditions climatiques y sont assez différentes avec des saisons mieux marquées dans la seconde île par rapport à la première. En revanche, certains Mollusques que nous n'avions pas récoltés dans ces mêmes milieux à Fangataufa ou aux Gambier colonisent les récifs extérieurs de Raevavae (*Latirus nodatus*, *Peristernia nassatula*). (2) Comme nous l'avions déjà observé dans l'étude des Gambier, la pente externe en pente douce, au delà du front du récif, réduit les actions hydrodynamiques de la houle créant ainsi des conditions de milieu qui retentissent sur la faune malacologique, qualitativement et quantitativement. L'absence de récifs extérieurs d'îlots très battus, fréquents sur les bordures au vent des atolls, est donc un trait commun aux récifs barrière des deux îles hautes volcaniques étudiées, Gambier et Raevavae.

Par ces travaux malacologiques réalisés à Fangataufa, aux Gambier et à Raevavae nous avons; (1) mis en évidence l'homogénéité de la faune des récifs extérieurs d'îlots, (2) établi la bionomie des espèces, (3) étudié les différences entre récifs au vent et sous le vent, (4) réalisé un bilan quantitatif des Mollusques des récifs extérieurs (nombre d'individus et biomasses). Quelques autres travaux seront nécessaires pour avoir une vue d'ensemvle valable à l'échelle de la Polynésie française notamment en prospectant des atolls plus septentrionaux dans les Tuamotu, et quelques récifs extérieurs d'îles hautes des archipels de la Société et des Marquises.

LITERATURE CITED

DAUTZENBERG, Ph. & BOUGE, J. L. 1933. Mollusques testacés marins des Etablissements français de l'Océanie. *J. Conchyliol.*, **77**: 41-108, 145-326, 351-469.

ODUM, E. P. & ODUM, H. T. 1955. Trophic structure and productivity of a windward coral reef Community on Eniwetok atoll. *Ecol. Monogr.*, **25**: 291-320.

REHDER, H. A. 1966. Cypraea in the Tubuai (Austral Islands). *Hawaiian Shell News*, **14**(14): 2 et 7.

SALVAT, B. 1967. Importance de la faune malacologique dans les atolls polynésiens. *Cahiers du Pacifique*, **11**: 7-49.

SALVAT, B. 1969. Mollusc distribution on seaward reefs of Fangataufa atoll (Tuamotu, Polynesia) - Quantitative transects, Biomass. *Symposium on corals and coral reefs*, Mandapam Camp, India, Abst. p 20-21, Mar. biol. Assoc., India, (sous presse).

SALVAT, B. 1970a. Etudes quantitatives sur les Mollusques récifaux de l'atoll de Fangataufa (Tuamotu, Polynésie), *Cah. Pacif.*, **14**: 1-57.

SALVAT, B. 1970b. Les Mollusques des "Récifs d'îlots" du Récif barrière des îles Gambier (Polynésie) - Bionomie et densités de peuplement. *Bull. Mus. natn. Hist. natur.*, Paris, ser. 2, **42**(3): 525-542.

SCHILDER, F. A. 1965. The Geographical Distribution of Cowries, *Veliger*, **7**: 171-183.

SCHILDER, F. A. 1966. Cowries from the Austral Island. *Hawaiian Shell News*, **14**(12): 4.

LISTE DES MOLLUSQUES RECOLTES ET CITES DANS LE TEXTE

GASTROPODA
ARCHAEOGASTROPODA
Patellidae
Patella stellaeformis Reeve, 1842
Trochidae
Trochus calcaratus Souverbie, 1875
Turbinidae
Turbo setosus (Gmelin, 1791)
Astralium petrosum (Philippi, 1848)
Neritidae
Nerita plicata Linné, 1758
Nerita polita Linné, 1758
Nerita albicilla Linné, 1758
Nerita morio (Sowerby, 1832)
MESOGASTROPODA
Littorinidae
Littorina coccinea (Gmelin, 1791)
Vermetidae
Vermetus maximus Sowerby, 1825
Cerithiidae
Cerithium columna Sowerby, 1855
Cerithium sinensis (Gmelin, 1791)
Cerithium nesioticum Pilsbry & Vanata, 1905
Cerithium lineatum Lamarck, 1843
Cerithium piperitum Sowerby, 1855
Strombidae
Strombus gibberulus Linné, 1758
Strombus mutabilis Swainson, 1821
Lambis (*Lambis*) *truncata* (Kiener, 1843)
Vanikoridae
Vanikoro petitiana (Recluz, 1843)
Hipponicidae
Hipponyx pilosus (Deshayes, 1831)
Cypraeidae
Cypraea obvelata Lamarck, 1810
Cypraea caputserpentis Linné, 1758
Cypraea moneta Linné, 1758
Naticidae
Natica marochiensis (Gmelin, 1791)
Cymatiidae
Cymatium (*Lampusia*) *chlorostomum* (Lamarck, 1822)
Cymatium (*Gutturnium*) *muricinum* (Broderip, 1798)
Bursidae
Bursa bufonia (Gmelin, 1971)
NEOGASTROPODA
Muricidae
Ricinula cancellata (Quoy & Gaimard, 1832)
Drupa elata (Blainville, 1832)
Drupa fiscella (Gmelin, 1791)
Drupa grossularia Röding, 1798
Drupa horrida (Lamarck, 1816)
Drupa morum Röding, 1798
Drupa ricinus (Linné, 1758)
Morula granulata (Duclos, 1832)
Pyrenidae
Columbella versicolor Sowerby, 1832
Buccinidae
Cantharus fumosus (Dillwyn, 1817)
Cantharus undosus (Linné, 1758)
Engina alveolata (Kiener, 1836)
Nassariidae
Nassarius concinna (Powis, 1835)
Fasciolariidae
Latirus nodatus (Gmelin, 1791)
Peristernia nassatula (Lamarck, 1822)
Mitridae
Strigatella litterata (Lamarck, 1811)
Conidae
Conus (*Puncticulis*) *pulicarius* Hwass, 1792
Conus (*Virgiconus*) *flavidus* Lamarck, 1822
Conus (*Virroconus*) *lividus* Hwass, 1792
Conus (*Virroconus*) *chaldaeus* Röding, 1798
Conus (*Virroconus*) *coronatus* Gmelin, 1791
Conus (*Virroconus*) *ebraeus* Linné, 1758
Conus (*Virroconus*) *miliaris* Hwass, 1792
Conus (*Virroconus*) *sponsalis* Hwass, 1792
ENTOMOTAENIATA
Pyramidellidae
Pyramidella propinqua A. Adams, 1853
CEPHALASPIDEA
Atyidae
Atys parallèla (Gould, 1847)
BASOMMATOPHORA
Siphonariidae
Siphonaria sp.
NOTASPIDEA
Umbraculidae
Umbraculum sp.
LAMELLIBRANCHIATA
FILIBRANCHIA
Arcidae
Arca plicata Dillwyn, 1795
Mytilidae
Mytilus sp.
Modiolus auriculatus Krauss, 1848

Isognomonidae
Isognomon isognomum (Linné, 1758)
Isognomon sulcata (Lamarck, 1819)
Pteriidae
Pinctada maculata (Gould, 1850)
EULAMELLIBRANCHIA
Trapeziidae
Trapezium oblongum (Linné, 1758)
Lucinidae
Codakia divergens (Philippi, 1850)
Codakia tigerina (Linné, 1758)
Chamidae
Chama asperella Lamarck, 1819
Chama imbricata Broderip, 1834
Cardiidae
Fragum fragum (Linné, 1758)
Tridacnidae
Tridacna maxima (Röding, 1798)
Veneridae
Venus reticulata Linné, 1758
Gafrarium pectinatum (Linné, 1758)
Tellinidae
Tellina scobinata Linné, 1758
Tellina robusta Hanley, 1844
Tellina rugosa Born, 1778
Sanguinolariidae
Asaphis deflorata (Linné, 1758)
CEPHALOPODA
Octopus sp.

BERNARD SALVAT
Laboratoire de Biologie Marine et Malacologie
Ecole Pratique des Hautes Etudes
et
Laboratoire de Malacologie
Museum National d'Histoire Naturelle
55 *Rue Buffon, PARIS* 5e, *France*

Malacological Review, 1971, 4: 17-20

THE STEPWISE MULTIPLE REGRESSION METHOD FOR SELECTION OF VARIABLES FOR PREDICTING THE SHELL WEIGHT OF FRESHWATER MUSSELS

Billy G. Isom

ABSTRACT

The stepwise multiple regression method was used for selection of variables for predicting the shell weight of the freshwater mussel *Pleurobema cordatum* (Rafinesque, 1820). Analyses showed that regression of weight on width of the bivalves gave a correlation coefficient (R^2) of 0.9240. The regression of weight on length R^2 of 0.9591 was 0.0351 more than width, but the easier measurement of width indicates it would be the best single measure for predicting shell weight of *P. cordatum*.

The objective of this study was to determine which of several independent variables were related to weight of mussels and to rate these variables in order of their importance for prediction of shell weight. Selection of a single variable of the set that could be measured in the field and yield a high degree of confidence was the primary goal of the experiment. Valve thickness constitutes the most desirable morphometric quality in selection of shells for commercial use, while hardness is the most desirable physical quality.

Data for 4 variables were available for analyses. These variables were weight (wt), height (h), width (w), and length (l) measurements on the freshwater mussel *Pleurobema cordatum* (Rafinesque, 1820). Weight was designated as the dependent variable in these analyses.

The data analyzed were collected by the author in 1963-1964 below Guntersville Dam, Tennessee River (Isom, 1969). The 32 sets of data were taken in 468 one-third-square-yard bottom samples. These samples were taken randomly from one-tenth-square-mile plots. *Pleurobema cordatum* is a species that has been and continues to be of great value to the freshwater bivalve industry in the Tennessee Valley. Animals are taken with commercial gear (brails) and sold to buyers who in turn sell the shells to Japanese representatives of the cultured pearl industry. The shells are cut and turned into round beads that are used as nuclei for cultured pearls.

A stepwise multiple regression program was used to find and evaluate the variables with the best multiple correlation (R^2) for prediction of the Y variable (wt) of *Pleurobema cordatum*. A computer program was used to compute all cross-products of the independent variables (w, h, and l) as shown in Table 1. Computations were made on the IBM 360-67 computer at the University of Michigan, using a canned program, BMDO2R, stepwise regression. Table 2 is a list of the values for the dependent variable (Y), the independent variables (X_i) and the cross-products of the independent variables. A computer program was also used to punch data cards containing the information noted in Table 2.

The multiple linear regression model is $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_k X_k + \varepsilon$ where α and β_i are constants and where the errors ε are distributed independently with zero mean and variance σ^2 (Snedecor & Cochran, 1967).

R^2 is the fraction of the sum of squares of deviations of Y from its mean that is attributable to the regression while $(1-R^2)$ is the fraction not associated with

TABLE 1. Variable name and number

Weight (gm) - wt	1
Width (mm) - w	2
Height (mm) - h	3
Length (mm) - l	4
Width x height	5
Width x length	6
Height x length	7
Width x height x length	8

the regression. One hundred times R^2 equals the percent sum of squares of deviations of Y from its mean that is attributable to the regression. If R^2 is a small fraction of unity, variation in Y is unexplained due to random variation or independent variables not considered in the regression.

The computer analysis starts with the regression of Y on the X_i variable shown to give the greatest reduction in the sum of squares of Y. The variable that made the next greatest contribution was then selected and the process continued until an additional contribution b_i^2/c_{ii} was too small to satisfy rules for inclusion (F-level 0.01 included, F-level 0.005 deleted) with a tolerance level of 0.001. The regression of weight on each single variable, on each pair of variables, and on the single triplet variable was calculated. The program also gave means and standard deviations.

Analyses indicate that weight of the shells of *Pleurobema cordatum* are highly correlated with all of the independent variables. The computer analysis established that variable 8 (Table 2) and weight R^2 was 0.9920. This is an unusually high correlation coefficient for biological material as compared with many of those noted in Snedecor & Cochran (1967). Weight on variable 6 R^2 of 0.9883 was the 2nd greatest contribution to reduction in the residual sum of squares of Y. R^2 for length and weight was 0.9591. Further analysis of the data involved only the regression of weight on width which revealed an R^2 of 0.9240.

Knowledge of the ecology of the species and of its commercial uses indicates that thickness of the individual valves of *Pleurobema cordalum* is the most desirable quality; the thicker the valves the larger and better are the nuclei that can be made from the shells. Therefore, thickness of the individual valves would be a desirable measurement, but such a measurement can be made only after the animal is removed. An alternative method would be to simply measure the greatest width of the intact bivalves, if high correlation existed between width and weight. As already noted, weight was more highly correlated with length than width; however, measurement on length in bivalves entails some ambiguity since the anterio-posterior plane is not often easily recognized, whereas width is easily measured. Since the difference in R^2 between length and weight and width and weight is only 0.0351, width would be the more desirable measure to make in the "real world." This would result in only a minor error in prediction of weight, but at less cost.

TABLE 2. Original input data and data calculated by computer program

Case No.	Wt (1)	W (2)	H (3)	L (4)	W. H. (5)	W. L. (6)	H. L. (7)	W. H. L. (8)
1	9.700	18.6	27.0	28.4	502.20	528.20	766.80	14262.50
2	9.400	18.6	25.4	28.5	472.40	530.10	723.90	13464.50
3	15.800	22.2	31.3	32.9	694.90	730.40	1029.80	22860.90
4	12.300	19.9	29.3	33.0	583.10	656.70	966.90	19241.30
5	16.200	22.2	30.3	34.0	672.70	754.80	1030.20	22870.40
6	13.900	20.5	31.6	34.6	647.80	709.30	1093.40	22413.90
7	17.600	23.0	33.9	36.1	779.70	830.30	1223.80	28147.10
8	21.600	24.6	35.1	36.3	863.50	893.00	1274.10	31343.60
9	19.600	24.2	32.4	36.9	784.10	893.00	1195.60	28932.50
10	20.800	23.2	34.4	36.9	798.10	856.10	1269.40	29449.10
11	18.300	23.6	33.6	37.6	793.00	887.40	1263.40	29815.30
12	26.300	24.1	39.1	42.8	942.30	1031.50	1673.50	40330.80
13	33.100	27.4	42.0	46.0	1150.80	1260.40	1932.00	52936.80
14	37.100	27.8	45.6	48.9	1267.70	1359.40	2229.80	61989.50
15	45.900	29.3	49.4	50.5	1447.40	1479.60	2494.70	73094.60
16	43.400	32.9	43.5	51.5	1431.10	1694.30	2240.20	73704.20
17	49.100	32.2	45.5	52.9	1465.10	1703.40	2406.90	77503.80
18	52.200	32.5	49.2	56.8	1599.00	1846.00	2794.60	90823.10
19	62.300	35.1	52.4	57.2	1839.20	2007.70	2997.30	105204.40
20	66.800	35.5	53.4	58.8	1895.70	2087.40	3139.90	111467.10
21	79.700	37.7	53.4	61.7	2013.20	2326.10	3294.80	124213.10
22	83.800	40.7	60.8	62.5	2474.60	2543.70	3800.00	154659.90
23	86.400	38.7	63.0	65.0	2438.10	2515.50	4095.00	158476.40
24	109.100	45.0	60.9	67.8	2740.50	3051.00	4129.00	185805.80
25	120.700	43.1	65.5	69.7	2823.00	3004.10	4565.30	196766.50
26	96.500	38.7	61.8	70.0	2391.70	2709.00	4326.00	167416.10
27	111.200	41.2	64.0	72.9	2636.80	3003.50	4665.60	192222.70
28	117.200	40.0	62.3	74.4	2492.00	2976.00	4635.10	185404.70
29	140.500	46.1	66.3	74.6	3056.40	3439.10	4946.00	228009.50
30	135.600	44.9	68.9	77.7	3093.60	3488.70	5353.50	240373.40
31	155.000	44.0	76.0	87.4	3344.00	3845.60	6642.40	292265.60
32	151.600	44.4	68.8	88.0	3054.70	3907.20	6054.40	268815.20

CONCLUSIONS

The stepwise multiple regression technique showed that volume (w × h × l) is the best measure for prediction of weight (Y) of *Pleurobema cordatum.*

The best single measure for prediction of weight was length.

Further analysis and knowledge of the ecology and qualitatively desirable characteristics of shells used in the pearl culture industry indicate width of the intact bivalve is a good predictor of weight. Width denotes a good correlation with weight, with an R^2 value of 0.9240, and would be an easy and cheap measure for the prediction of weight of a population of *Pleurobema cordatum*.

The stepwise multiple regression method of analysis would seem adaptable to study clinal characteristics often noted in *Pleurobema cordatum* and other bivalves as well as gastropods. However, correlation analysis (Cvancara, 1963), partial correlation analysis, or the discriminant function (Snedecor & Cochran, 1967) may be better tools for clinal studies.

Knowledge of the different morphometries of various clines and their relation to weight would be a valuable tool for determining the value of mussel shells from a given locality for use in the culture of pearls or for classification studies.

Other variables, such as water quality, could be introduced. Calcium, hardness and current velocity, for example, could be correlated with morphometric data. Addition of such variables introduces the possibility of added correlation among X_i values which makes determination of the most important variable more difficult. Since, for example, calcium constitutes better than 99% of bivalve shells, calcium content of the water should be correlated with all X_i variables (shell morphometry).

Variable 8 (Table 2) and weight correlation coefficient (R^2) of 0.992 indicates 99.2% of the variation in Y can be attributed to its linear regression on variable 8. Variable 6 (Table 2) and weight correlation coefficient of 0.9883 indicates 98.8%, variable 4 (Table 2) and weight, 95.9%; and variable 2 and weight, 92.4% of the variation of Y that can be attributed to its linear regression on these X variables.

LITERATURE CITED

CVANCARA, A. M. 1963. Clines in three species of *Lampsilis* (Pelecypoda: Unionidae). *Malacologia*, 1(2): 215-225.

ISOM, B. G. 1969. The mussel resource of the Tennessee River. *Malacologia*, 7(2-3): 397-425.

SNEDECOR, G. W. & COCHRAN, W.G. 1967. *Statistical Methods*. Iowa State Univ. Press, 593 p.

B. G. ISOM

Environmental Biology Branch
Division of Environmental Research and Development
Tennessee Valley Authority
Muscle Shoals, Alabama 35660
U. S. A.

MALACOLOGICAL REVIEW, P.O.Box 801, Whitmore Lake, Michigan 48189, U.S.A.

Malacological Review, 1971, 4: 21-24

THE HOLD-FAST FUNCTION OF THE PREPUTIAL ORGAN IN *HELISOMA* [1]

Gary L. Pace

ABSTRACT

The mating behavior of *Helisoma anceps* (Menke), *H. trivolvis* (Say), *H. duryi* (Wetherby), and *H. scalare* (Jay) is very similar with respect to the function of the preputial organ. Rather than serving as a self-stabilizing brace as previously described, this structure was found to act as a hold-fast attaching to the mate. Each snail is attached by its foot to the left apertural lip of the mate's shell. Usually, the preputial organ crosses over the mate's "neck" and attaches like a suction-cup to the dorsal or right dorso-lateral surface of the mate's head-foot region. Occasionally, this organ may reach the right side of the mate by extending around and ventral to the mate's "neck," just dorsal to the posterior slope of the foot. Still more rarely, the hold-fast was seen attached to the inside of the left lip of the mate's shell, acting as a wedge and a brace against which pressure could be applied while forcing the 2 snail's genitalia into close proximity.

The existence of a "penial gland" in the preputium of planorbid snails of the genus *Helisoma* was first reported by Baker (1926). Since then, Baker (1931) has suggested that this "penial gland" might function in spermatophore formation, excitatory manipulation of the mate, or in the production of a secretion causing the dilation of genital openings through which the penis is protruded (1945). Malek (1952) felt that besides producing secretions which lubricate and dilate genital openings, this organ also acts as a tactile sense organ before mating and as a self-bracing hold-fast organ during mating. Of the several functions proposed, Malek's interpretation seems to have been most nearly correct. The present report contains further observations on the preputial organ during copulation, changing the interpretation of its function to that of a hold-fast attaching to the mate.

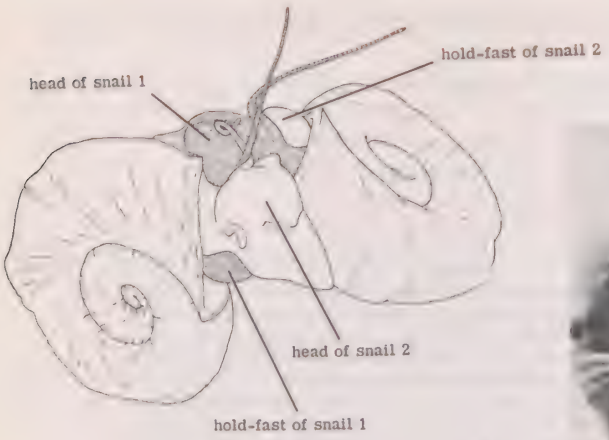
MATERIALS AND METHODS

Observations were made of the mating behavior of 4 species of the genus *Helisoma*, *H. anceps* (Menke), *H. trivolvis* (Say), *H. duryi* (Wetherby) and *H. scalare* (Jay). The first 2 species were collected in Michigan, the last 2 in Florida. Observations were made using a Wild M 5 Stereoscopic microscope. Photographic records were obtained with an Exacta VX camera with a Makro-Kilar 40 mm lens or a 200 mm telephoto lens mounted to the camera by extension tubes.

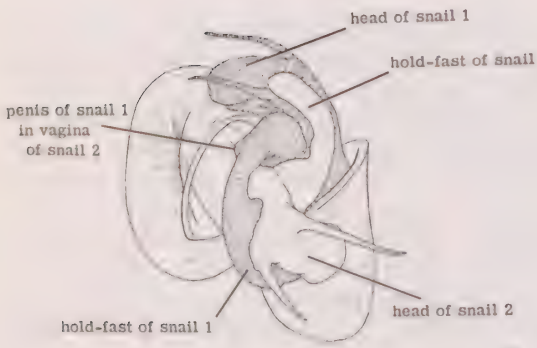
RESULTS

Many mating pairs of each species were observed to follow very similar behavior patterns. Mating is usually initiated by reciprocal tentacular exploration between prospective mates. Soon each snail is found attached by its foot to the left apertural lip of the mate's shell. Very often the anterior left side of the foot partially obstructs the aperture of the mate's shell. If such a mating pair is viewed from the side at this stage, the 2 apertures face each other with the *left* side of one shell and the *right* side of the other visible to the observer. When

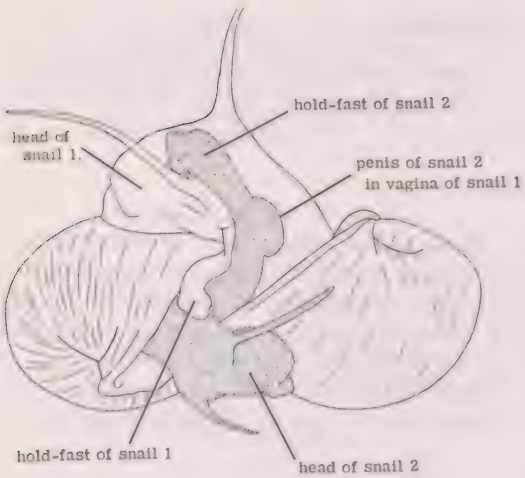
[1] This investigation was supported by N.I.H. Training Grant No. 5 T1 A1 41 from the National Institute of Allergy and Infectious Diseases, U.S. Public Health Service. The research was conducted in the Museum of Zoology, University of Michigan, Ann Arbor.



1



2



3

FIGS. 1 - 3. Copulating *Helisoma*. Each left hand figure is a labelled tracing of the figure to its right. FIG. 1. *H. trivolvis*. FIG. 2. *H. trivolvis* FIG. 3. *H. scalare*.

viewed from above, the part of each body whorl furthest from the observer is extended somewhat laterally in relation to the closely apposed apertures. Thus only the right sides of each shell are in view (Fig. 1). With the 2 left sides in close apposition, the animals are in an ideal relative position for mating. Once in this position, the preputial organ and the penis sac are everted. The preputial organ then begins movements suggesting tactile exploration as reported by Malek (1952). Usually, this organ soon finds its way over the "neck" of the mate where it attaches in a suction-cup manner to the dorsal (often between the tentacles) or *right* dorso-lateral surface of the mate's head-foot region (Figs. 2, 3). Occasionally, the preputial organ may attach to the right side of the mate by extending around and ventral to its "neck," just dorsal to the posterior slope of the foot. In a few cases, the preputial organ was not visible during copulation and was not attached to the right side of the mate's body. When the animals were forced apart, the preputial organ could be seen attached to the inside of the left lip of the mate's shell. In this position, the mate's shell is apparently used as a brace against which pressure may be applied while inserting the penis into the mate's vagina. Thus the preputial organ may be used either as a hold-fast structure functioning to pull the snails closer together, or as a wedge forced between the mate's shell and body, thus functioning to push the two snail's external genitalia into close proximity. In each case, however, the organ was definitely applied to the body or shell of the *mate*, not to that of the *same* snail as suggested by Malek (1952).

While the hold-fast attachment is being secured, the penis sac "finds" the vaginal opening and the penis is inserted (Figs. 2, 3). Malek (1952) correctly described the pulsation of the preputial organ while attached to the right sides of the animals during copulation. However, he was under the impression that each was attached to the right side of the *same* snail rather than to that of the *mate*.

CONCLUSIONS

The observations I have recorded above add to those of Malek (1952) on the hold-fast function of the preputial organ of helisome snails, and correct a previous misconception. It is easy to understand how a misinterpretation of the precise function of this organ during mating might develop. First, plasticity of these snails permits considerable distortion of their bodies. Secondly, and perhaps more important, during copulation these animals adhere to each other so closely that it is very difficult to distinguish the organs of each animal. An additional problem for interpretation appears to have been introduced during the preparation of Malek's text-fig. 1 (1952: 97). Here it appears that the *left* side of each snail's shell and the *right* side of each head-foot region is in view simultaneously. Also, Malek describes the preputial organ clasping the *same* snail just behind the right tentacle. This structure is shown extending from beneath the pseudobranch (structurally on the left) directly to its attachment on the same animal's right side. Since the preputium is everted through the male genital aperture just behind the left tentacle, such an arrangement seems functionally if not structually impossible. If Malek's illustration was prepared by tracing a projected image or a photographic print, the possibility exists that the slide or negative was reversed. Therefore, if Malek's figure is placed on a tracing table and traced through the page, a different interpretation results. This reversed view is comparable to my first figure (Fig. 1). Now the *right* side of each animal's shell is visible with the *left* side of each head-foot region. What was formerly considered the distal preputial organ in its hold-fast position on the right side is now seen to be the

proximal end of the everted penial complex protruding from just behind the left tentacle. The preputial organ is not visible in this view. While this interpretation assumes enough plasticity to allow twisting of the head-foot region relative to the visceral mass in the shell (frequently observed), it does not require, as would Malek's explanation, a 180° twist between immediately adjacent parts of the head-foot mass.

Thus in the 4 species of *Helisoma* observed, the preputial organ functions as a hold-fast organ, adhering to the *mate*, rather than as a brace on the neck of the *same* snail.

ACKNOWLEDGEMENTS

Sincere thanks are due to Dr. Henry van der Schalie, Dr. J. B. Burch, and Dr. Elmer G. Berry, curators of the Mollusk Division, Museum of Zoology at the University of Michigan for their criticism, encouragement and advice. Gratitude is also due to Dr. Robert Wall and Mr. James Scruggs for collecting the Michigan snails and to Dr. Fred G. Thompson for providing the Florida species.

LITERATURE CITED

BAKER, F. C. 1926. Nomenclatorial notes on American freshwater Mollusca. *Trans. Wisconsin Acad. Arts, Sci. and Lett.*, 22: 192-205.

BAKER, F. C. 1931. The classification of the large planorbid snails of Europe and America. *Proc. zool. Soc. London*, 1931 (2): 575-592.

BAKER, F. C. 1945. *The molluscan family Planorbidae*. Univ. Illinois Press. Collation, revision and additions by H. J. van Cleave, 530 pp.

MALEK, E. T. A. 1952. The preputial organ of snails in the genus *Helisoma* (Gastropoda: Pulmonata). *Amer. Midl. Natur.*, 48(1): 94-102.

G. L. PACE

Flint College
University of Michigan
Flint, Michigan 48503
U. S. A.

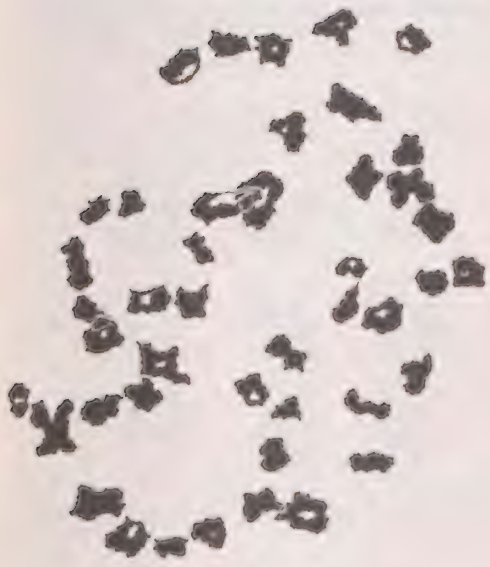
BRIEF COMMUNICATIONS

* * * * * * *

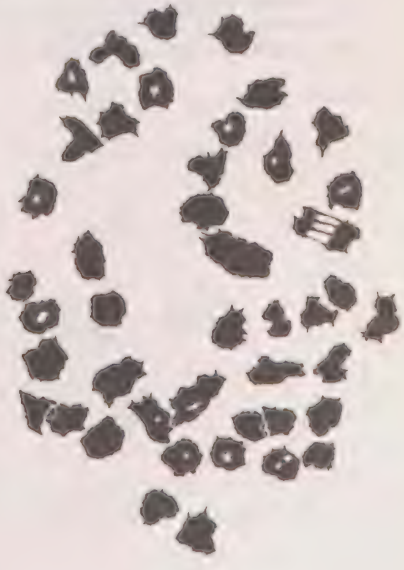
E CHROMOSOME NUMBER OF THE ATHORACOPHORID SLUG, *TRIBONIOPHORUS GRAEFFEI*, FROM AUSTRALIA.[1][2] — The chromosome numbers of mollusks are generally very conservative, seldom varying more than 1 or 2 (haploid) for any species of a particular family (see Burch, 1965; Patterson, 1969). One of the notable exceptions is in the stylommatophoran suborder Heterurethra, where the family Succineidae has species with chromosome numbers varying from n=5 to n=25, with haploid numbers 6, 11, 12, 15, 17, 18, 19, 21 and 22 occurring between these 2 extremes (see Patterson, 1969, 1970). The only other heterurethran family for which there are any chromosome data is the aberrant South Pacific slug family Athoracophoridae, *Aneitea* sp. from the New Hebrides having 44 pairs (Fig. 2) of chromosomes (Patterson, 1969). This is by far the highest chromosome number known for any stylommatophoran land snail, the next highest number reported being n=34 for 2 milacid slugs of the genus *Milax* (Beeson, 1960).

During September, 1970, we had the opportunity to obtain specimens of another athoracophorid slug, *Triboniophorus graeffei* Humbert, from a roadside *Melaleuca* forest 31 miles south of Grafton, New South Wales, Australia. A 1000 miles of ocean separate the Australian and New Hebridean forms which are discussed in this paper. Our specimens of *T. graeffei* were pale grey with the tannish color of the inner organs faintly showing through. The border of the foot and edge of the mantle shield were bright crimson, and 2 parallel darker gray bands ran the length of animal on each side of the dorsal mid-line (Fig. 1).

FIG. 1. Dorsal view of *Triboniophorus graeffei* Humbert.



2



3

FIGS. 2 and 3. Diakinesis chromosomes (♂) of athoracophorid slugs. Fig. 2. *Aneitea* sp. Fig. 3. *Triboniophorus graeffei*.

Cells undergoing male diakinesis in the ovotestis of *Triboniophorus graeffei* had 44 bivalents (Fig. 3). Therefore, this species has the same chromosome number as *Aneitea* sp. of the New Hebrides. The fact that the Australian and New Hebrides athoracophorid slugs have the same chromosome numbers indicates that the Athoracophoridae exhibit the same cytological conservativeness characteristic of most other snail groups. A similar conservativeness, although not seen for the family as a whole, is nevertheless usually evident at the generic or subgeneric level in the Succineidae.

Some of the anatomical peculiarities of the Athoracophoridae have recently been discussed by Burch (1968) and in regard to the related Succineidae by Burch & Patterson (1969). Although the 2 snail families obviously seem to be related, the wide separation in their chromosome numbers, if they are the result of aneuploidy, might well indicate that the 2 families have diverged considerably, and over a long period of time. On the other hand, even though polyploidy has not been demonstrated in the Stylommatophora, the high chromosome number of the athoracophorid slugs could possibly be the result of polyploidy. If such were the case, then the aberrant chromosome numbers found in the Athoracophoridae would have little bearing on their possible phylogenetic remoteness. It is evident that cytological studies should be extended to include more species of the Athoracophoridae, especially those species of New Caledonia and New Zealand.

LITERATURE CITED. — BEESON, G. E. 1960. Chromosome numbers of slugs. *Nature*, 108: 257-258. — BURCH, J. B. 1965. Chromosome numbers and systematics in euthyneuran snails. *Proc. 1st Europ. malacol. Congr.*, p 215-241. — BURCH, J. B. 1968. Tentacle retraction in Tracheopulmonata. *J. malacol. Soc. Austr.*, 1: 62-67. —BURCH, J. B. & PATTERSON, C. M. 1969. The systematic position of the Athoracophoridae (Gastropoda: Euthyneura). *Malacologia*, 9: 259-260. — PATTERSON, C. M. 1969. Chromosomes of mollusks. *Proc. Symp. Moll.*, Mar. biol. Assoc. India, Pt, p 635-686. — PATTERSON, C. M. 1970. Morphological and cytological studies of the succineid genus *Quickia* from India. *Malacol. Rev.*, 3: 25-36.

* * * * * * *

J. B. BURCH and C. M. PATTERSON, *Museum and Department of Zoology, The University of Michigan, Ann Arbor, Michigan* 48104, *U.S.A.*

(1) Supported by Training Grant 5 T1 AI 41 from the National Institute of Allergy and Infectious Diseases, U.S. Public Health Service.

(2) Grateful acknowledgement is made to Dr. W. F. Ponder and the Australian Museum for providing field transportation, to Mr. Philip Colman for field assistance, and to Mr. John L. Tottenham for the illustration of *Triboniophorus graeffei*.

* * * * * * *

A KARYOTYPE TECHNIQUE USING FRESHWATER SNAIL EMBRYOS.[1][2] — Chromosome number and morphology are 2 important aspects of the karyotype which has long been recognized as a species specific character of considerable value to the taxonomist and cytogeneticist (White, 1954; Swanson, 1957). Chromosome numbers have been reported for over 565 molluscan species (see Patterson, 1970), but karyotypes which include a record of chromosome morphology have been presented for only very few (less than 25) species. Molluscan cytotaxonomists have used mainly gonadal tissues for chromosome studies. Gonadal tissue yields mainly cells in meiotic stages where chromosome morphology useful for characterizing a karyotype is not evident. Generally, if mitotic cells are present, the complement of chromosomes is firmly attached to the spindle, rendering chromosome morphology indiscernible due to excessive crowding. Other molluscan tissues do not seem to be suitable for chromosome studies due to the lack of active cell division or, because of its structure, the tissue does not squash well. Burch (1968) described a method of tissue culture for land snail ovotestes in a medium containing colchicine, which produced c-mitoses useful for karyotypes. However, tissue culture is a time-consuming endeavor during which sterile conditions must be maintained. Thus, one can readily understand why so few molluscan karyotypes have been elucidated.

Longwell *et. al.* (1967), using oyster embryos, obtained mitotic chromosomes suitable for karyotypes by adding colchicine to the sea water in which the embryos were kept. The purpose of the current brief communication is to describe a method used to obtain mitotic chromosomes suitable for karyotypes from freshwater pulmonate snail (in this example, *Bulinus tropicus*) embryos.

The technique which was successfully used is described as follows. Embryos which range from 8-cell to blastula stage are dissected from the egg capsule, using fine watchmaker's forceps, into an isotonic solution of 0.04% NaCl with 0.00025% of the spindle inhibitor vinblastine sulfate (trade name "Velban", Eli Lilly & Co., U.S.A.) contained in a 10 ml capacity covered stendor dish. After 2-3 hours incubation, 1/2 of the solution is withdrawn and replaced by 0.02% NaCl. The embryos remain in this hypotonic solution 1/2 hour, after which the procedure is repeated giving a 0.025% NaCl with 0.0000675% inhibitor concentration. The treatment in hypotonic saline seems to be necessary because it insures good chromosome spreads during the squash preparation and the individual chromosomes are more extended, rendering morphological characters of the chromosomes clearly evident. After 1/2 hour in the last solution, the liquid is withdrawn and fixative (acetic acid and 95% ethanol, 1:3 parts by volume) added. Squash preparations are made immediately using concentrated acetic orcein stain, a 45% acetic acid rinse and mounting in 45% actic acid (for temporary preparations). The embryos are very small (100 micra or less) and therefore must be transferred to the slide with a pipette. Fig. 1 shows the karyotype of *Bulinus tropicus*. (Fig. 2) is presented.

LITERATURE CITED. — BURCH, J. B. 1968. A tissue culture technique for caryotype analyses of pulmonate land snails. *Venus, Jap. J. Malacol.*, 27(1): 20-27. — LONGWELL, A. C., STILES, S. S., & SMITH, D. G. 1967. Chromosome complement of the American oyster *Crassostrea virginica*, as seen in meiotic and cleaving eggs. *Can. J. Genet. Cytol.*, 9(4): 845-856. — PATTERSON, C. M. 1970. Chromosomes of molluscs. *Proc. Symp. Moll.*, Mar. biol. Assoc. India, Pt. II: 635-686. — SWANSON, C. P. 1957. *Cytology and cytogenetics*. Prentice-Hall, Inc., Englewood Cliffs, N.J., 596 p. — WHITE, M. J. D. 1954. *Animal cytology and evolution*. Cambridge University Press, Cambridge, England, 454 p.

* * * * * * *

C. M. PATTERSON, *Museum and Department of Zoology, University of Michigan, Ann Arbor, Michigan* 48104, *U.S.A.*

(1) Supported (in part) by Training Grant 5 T1 AI-41 and by grant AI-07270 from the National Institutes of Allergy and Infectious Diseases, Washington, D.C.

(2) Thanks are due Dr. J. B. Burch and Mr. S.-K. Wu for the snails and embryos used in this study.

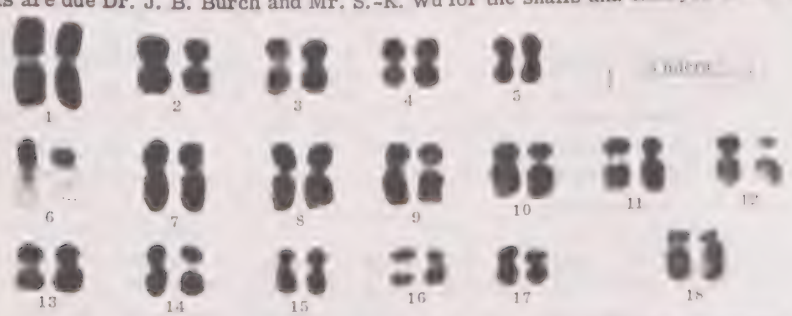


FIG. 1. Karyotype of *Bulinus tropicus* composed of 5 metacentric chromosome pairs, 12 submetacentric pairs and 1 pair (18) which is subacrocentric. Pair 6 is distinct because 2 arms of each chromosome are very lightly stained.

Malacological Review, 1971, 4: 29-40

ABBREVIATED TITLES OF SCIENTIFIC JOURNALS AND PLACE NAMES TO BE USED IN LITERATURE CITATIONS IN *MALACOLOGICAL REVIEW*

The journals, other publications and place names listed here are those cited by authors in previous issues of *Malacological Review*, as well as many cited in our affiliated journal, *Malacologia*. These lists are by no means complete, but they do include most of those publications and place names likely to be cited repeatedly by our contributors, as well as some rarer ones. Authors preparing manuscripts are requested to refer to these lists when preparing their bibliographies for *Malacological Review*.

Journal Abbreviations

Abhandlungen der Deutschen Akademie der Wissenschaften zu Berlin	*Abh. dtsch. Akad. Wiss. Berlin*
Abhandlungen hrsg. von der Senckenbergischen naturforschenden Gesellschaft	*Abh. Senckenberg. naturforsch. Ges.*
Acta biologica Academiae scientiarum hungaricae	*Acta biol. Acad. Sci. hung.*
Acta cytologica	*Acta cytol.*
Acta Geologica Hispanica	*Acta geol. hispanica*
Acta physiologica et pharmacologica néerlandica	*Acta physiol. Pharmacol. néerl.*
Acta zoologica	*Acta zool.*
Acta zoologica fennica	*Acta zool. fenn.*
Advance Abstracts of Contributions on Fisheries and aquatic Sciences in India	*Adv. Abstr. Contr. Fish. aquat. Sci. India*
Advances in Protein Chemistry	*Advan. Protein Chem.*
Allgemeine Forstzeitschrift	*Allg. Forstz.*
Ameghiniana	*Ameghiniana*
American Geologist	*Amer. Geol.*
American Journal of Conchology	*Amer. J. Conchol.*
American Journal of Hygiene	*Amer. J. Hyg.*
American Journal of Science	*Amer. J. Sci.*
American Journal of Tropical Medicine and Hygiene	*Amer. J. trop. Med. Hyg.*
American Malacological Union, Inc., Annual Reports	*Amer. malacol. Union, ann. Reps.*
American Midland Naturalist	*Amer. Midl. Natur.*
American Museum Novitates	*Amer. Mus. Novit.*
American Naturalist	*Amer. Natur.*
American Scientist	*Amer. Sci.*
American Zoologist	*Amer. Zool.*
Anatomical Record	*Anat. Rec.*
Annales d'endocrinologie	*Ann. Endocrinol.*
Annales de la Faculté des sciences de Marseille	*Ann. Fac. Sci. Marseille*
Annales du Musée d'histoire naturelle de Marseille	*Ann. Mus. Hist. natur. Marseille*
Annales, Musée royal de l'Afrique centrale	*Ann. Mus. roy. Afr. centr.*
Annales du Musée royal du Congo belge	*Ann. Mus. roy. Congo belge*
Annales de parasitologie humaine et comparée	*Ann. Parasitol. hum. comp.*
Annales des sciences naturelles (Zoologie)	*Ann. Sci. natur. (Zool.)*
Annales de la Société royale zoologique de Belgique	*Ann. Soc. roy. Zool. Belg.*
Annales zoologici	*Ann. zool.*
Annals and Magazine of Natural History	*Ann. Mag. natur. Hist.*

Annals of the Natal Museum	*Ann. Natal Mus.*
Annals of the New York Academy of Sciences	*Ann. N.Y. Acad. Sci.*
Annals of Scottish Natural History	*Ann. Scot. natur. Hist.*
Annals of the South African Museum	*Ann. S. Afr. Mus.*
Annals of Tropical Medicine and Parasitology	*Ann. trop. Med. Parasitol.*
Annotationes zoologicae japonenses	*Annot. zool. jap.*
Arbeiten aus den Zoologischen Instituten der Universität Wien u. der Zoologischen Station in Triest	*Arb. zool. Inst. Univ. Wien*
Archiv für Anatomie und Physiologie	*Arch. Anat. Physiol.*
Archiv für experimentelle Zellforschung	*Arch. exp. Zellforsch.*
Archiv für Hydrobiologie	*Arch. Hydrobiol.*
Archiv für Mikroskopische Anatomie und Entwicklungsmechanik	*Arch. mikrosk. Anat. Entwickl.-mech.*
Archiv für Molluskenkunde	*Arch. Molluskenk.*
Archiv für Naturgeschichte	*Arch. Naturgesch.*
Archives d'anatomie, d'histologie et d'embryologie	*Arch. Anat. Histol. Embryol.*
Archives d'anatomie microscopique et de morphologie expérimentale	*Arch. Anat. microsc. Morphol. exp.*
Archives de biologie	*Arch. Biol.*
Archives italiennes de biologie	*Arch. ital. Biol.*
Archives néerlandaises de physiologie de l'homme et des animaux	*Arch. néerl. Physiol.*
Archives néerlandaises de zoologie	*Arch. néerl. Zool.*
Archives de zoologie expérimentale et générale	*Arch. Zool. exp. gén.*
Archivio zoologico italiano	*Arch. zool. ital.*
Archivos de zoologia do Estado de São Paulo	*Arch. Zool. Est. São Paulo*
Argamon	*Argamon*
Arkiv för zoologi	*Ark. Zool.*
Atti dell'Accademia nazionale dei Lincei. Rendiconti	*Atti Accad. naz. Lincei, Rc.*
Atti della Società toscana di scienze naturali residente in Pisa	*Atti Soc. tosc. Sci. natur. Pisa*
Auk	*Auk*
Australian Journal of Experimental Biology and Medical Science	*Austr. J. exp. Biol. med. Sci.*
Australian Journal of Marine and Freshwater Research	*Austr. J. mar. freshw. Res.*
Australian Journal of Zoology	*Austr. J. Zool.*
Basteria	*Basteria*
Beaufortia	*Beaufortia*
Bergens museums årbog	*Bergens Mus. Årb.*
Biochimica et biophysica acta	*Biochim. biophys. Acta*
Biological Bulletin	*Biol. Bull.*
Biological Journal of the Linnean Society of London	*Biol. J. Linn. Soc. Lond.*
Biological Journal of Okayama University	*Biol. J. Okayama Univ.*
Biological Reviews	*Biol. Rev.*
Biologische Untersuchungen	*Biol. Unters.*
Biologisches Zentralblatt	*Biol. Zentralbl.*
Boletim do Instituto oceanográfico	*Bol. Inst. oceanogr.*
Boletín de la Asociación médica de Puerto Rico	*Bol. Asoc. méd. P. Rico*

Bollettino di pesca, piscicoltura e idrobiologia	*Boll. Pesca Piscic. Idrobiol.*
Bollettino della Società malacologica italiana	*Boll. Soc. malacol. ital.*
Bollettino di zoologia, pubblicato dall'Unione zoologica italiana	*Boll. Zool.*
Breviora	*Breviora*
British Birds	*Brit. Birds*
British Medical Bulletin	*Brit. med. Bull.*
Bulletin de l'Académie polonaise des sciences	*Bull. Acad. pol. Sci.*
Bulletin of the American Museum of Natural History	*Bull. Amer. Mus. natur. Hist.*
Bulletins of American Paleontology	*Bull. Amer. Paleont.*
Bulletin of the Azabu Veterinary College	*Bull. Azabu vet. Coll.*
Bulletin biologique de la France et de la Belgique	*Bull. biol. Fr. Belg.*
Bulletin of the British Museum (Natural History)	*Bull. Brit. Mus. (natur. Hist.)*
Bulletin of California State Mining Bureau	*Bull. Calif. St. mining Bur.*
Bulletin of the Florida State Museum. Biological Sciences	*Bull. Fla. St. Mus., biol. Sci.*
Bulletin of the Geological Society of America	*Bull. geol. Soc. Amer.*
Bulletin de l'Institut océanographique	*Bull. Inst. océonogr.*
Bulletin de l'Institut royal des sciences naturelles de Belgique	*Bull. Inst. roy. Sci. natur. Belg.*
Bulletin of the Japanese Society of Scientific Fisheries	*Bull. Jap. Soc. sci. Fish.*
Bulletin of the Los Angeles County Museum of Natural History	*Bull. Los Angeles Co. Mus. natur. Hist.*
Bulletin of Marine Science of the Gulf and Caribbean	*Bull. mar. Sci. Gulf Caribb.*
Bulletin mensuel de la Société linnéenne de Lyon	*Bull. mens. Soc. linn. Lyon*
Bulletin du Musée royal d'histoire naturelle de Belgique	*Bull. Mus. roy. Hist. natur. Belg.*
Bulletin of the Museum of Comparative Zoology at Harvard College	*Bull. Mus. comp. Zool. Harvard Coll.*
Bulletin du Museum d'histoire naturelle	*Bull. Mus. Hist. natur.*
Bulletin. National Museum of Canada	*Bull., natn. Mus. Can.*
Bulletin of the National Science Museum	*Bull. natn. Sci. Mus.*
Bulletin of the New York Academy of Medicine	*Bull. N.Y. Acad. Med.*
Bulletin de la Société géologique de France	*Bull. Soc. géol. Fr.*
Bulletin de la Société d'histoire naturelle de Toulouse	*Bull. Soc. Hist. natur. Toulouse*
Bulletin de la Société linnéenne de Normandie	*Bull. Soc. linn. Normandie*
Bulletin de la Société de pathologie exotique	*Bull. Soc. Pathol. exot.*
Bulletin de la Société zoologique de France	*Bull. Soc. zool. Fr.*
Bulletin of the Torrey Botanical Club	*Bull. Torrey bot. Club*
Bulletin. United States Geological Survey	*Bull., U.S. Geol. Surv.*
Bulletin. United States National Museum	*Bull., U.S. natn. Mus.*
Bulletin of the World Health Organization	*Bull. Wld. Hlth. Org.*
Bulletin of Zoological Nomenclature	*Bull. zool. Nomencl.*
Cahiers de biologie marine	*Cah. Biol. mar.*
Cahiers du Pacifique	*Cah. Pacif.*
California Journal of Mines and Geology	*Calif. J. Mines Geol.*
Canadian Journal of Microbiology	*Can. J. Microbiol.*
Canadian Journal of Zoology	*Can. J. Zool.*
Caribbean Journal of Science	*Caribb. J. Sci.*
Chesapeake Science	*Chesapeake Sci.*

Chromosoma	*Chromosoma*
Collecting and Breeding	*Collecting & Breed.*
Comparative Biochemistry and Physiology	*Comp. Biochem. Physiol.*
Compte rendu sommaire des séances de la Société géologique de France	*C.r. somm. Séanc. Soc. géol. Fr.*
Comptes rendus hebdomadaire des séances de l'Académie des sciences	*C.r. hebd. Séanc. Acad. Sci.*
Comptes rendus des séances de la Société de biologie	*C.r. Séanc. Soc. Biol.*
Comunicaciones de la Sociedad Malacológica del Uruguay	*Comun. Soc. malacol. Uruguay*
Conchiglie	*Conchiglie*
Condor	*Condor*
Contributions from the Laboratory of Vertebrate Biology of the University of Michigan	*Contr. Lab. vertebr. Biol. Univ. Mich.*
Contributions from the Museum of Paleontology, The University of Michigan	*Contr. Mus. Paleont. Univ. Mich.*
Contributions in Science	*Contr. Sci.*
Copeia	*Copeia*
Current Science	*Curr. Sci.*
Cytologia	*Cytologia*
Dissertation Abstracts	*Diss. Abstr.*
Doklady Akademii nauk SSSR	*Dokl. Akad. Nauk SSSR*
Doklady (Proceedings) of the Academy of Sciences of the U.S.S.R.	*Dokl. (Proc.) Acad. Sci. U.S.S.R.*
Echo	*Echo*
Ecological Monographs	*Ecol. Monogr.*
Ecology	*Ecology*
Endeavour	*Endeavour*
Ethiopian Medical Journal	*Eth. med. J.*
Evolution	*Evolution*
Experientia	*Experientia*
Experimental Parasitology	*Exp. Parasitol.*
Federation Proceedings. Federation of American Societies for Experimental Biology	*Fed. Proc., Fed. Amer. Socs. exp. Biol.*
Fieldiana: Zoology	*Fieldiana, Zool.*
Fishery Investigations. Ministry of Agriculture, Food and Fisheries	*Fish. Invest., Min. Agr. Food. Fish.*
Forma et Functio	*Forma et Functio*
Fossils	*Fossils*
Fragmenta faunistica	*Fragm. faun.*
General and Comparative Endocrinology	*Gen. compar. Endocrinol.*
Genetics	*Genetics*
Géobios	*Géobios*
Geologie	*Geologie*
Ghana Medical Journal	*Ghana med. J.*
Growth	*Growth*
Hallesches Jahrbuch für mitteldeutsche Erdgeschichte	*Hallesches Jb. mitteldtsch. Erdgesch.*
Handbuch der Zoologie	*Handb. Zool.*

Helgoländer wissenschaftliche Meeresuntersuchungen	*Helgoländer wiss. Meeresunters.*
Heredity	*Heredity*
Herpetologica	*Herpetologica*
Hyacinth Control Journal	*Hyacinth Control J.*
Illinois Biological Monographs	*Illinois biol. Monogr.*
Image	*Image*
Immunology	*Immunology*
In vitro	*In vitro*
Indian Journal of Medical Research	*Indian J. med. Res.*
Indo-Pacific Mollusca	*Indo-Pac. Moll.*
Ingenieur in Nederlandsch-Indië	*Ing. Ned.-Indië*
Israel Journal of Zoology	*Israel J. Zool.*
Japanese Journal of Genetics	*Jap. J. Genet.*
Japanese Journal of Parasitology	*Jap. J. Parasitol.*
Japanese Journal of Zoology	*Jap. J. Zool.*
Jenaische Zeitschrift für Naturwissenschaft	*Jena. Z. Naturwiss.*
Johnsonia	*Johnsonia*
Journal of the Academy of Natural Sciences of Philadelphia	*J. Acad. natur. Sci. Philad.*
Journal of Anatomy	*J. Anat.*
Journal of Animal Ecology	*J. anim. Ecol.*
Journal of Bacteriology	*J. Bacteriol.*
Journal of Biophysical and Biochemical Cytology	*J. biophys. biochem. Cytol.*
Journal of the Bombay Natural History Society	*J. Bombay natur. Hist. Soc.*
Journal of Cellular and Comparative Physiology	*J. cell. comp. Physiol.*
Journal de conchyliologie	*J. Conchyliol.*
Journal of Conchology	*J. Conchol.*
Journal of the Egyptian Medical Association	*J. Egypt. med. Assoc.*
Journal of Elisha Mitchell Scientific Society	*J. Elisha Mitchell sci. Soc.*
Journal of Experimental Biology	*J. exp. Biol.*
Journal of Experimental Marine Biology and Ecology	*J. exp. mar. Biol. Ecol.*
Journal of the Fisheries Research Board of Canada	*J. Fish. Res. Bd. Can.*
Journal of the Florida Academy of Science	*J. Fla. Acad. Sci.*
Journal of Geology	*J. Geol.*
Journal of Immunology	*J. Immunol.*
Journal of Invertebrate Pathology	*J. invert. Pathology*
Journal of the Linnean Society	*J. Linn. Soc.*
Journal of the Malacological Society of Australia	*J. malacol. Soc. Austr.*
Journal of Mammalogy	*J. Mammal.*
Journal of the Marine Biological Association of the United Kingdom	*J. mar. biol. Assoc. U.K.*
Journal of Marine Research	*J. mar. Res.*
Journal of Morphology	*J. Morphol.*
Journal of Natural History	*J. natur. Hist.*
Journal of Paleontology	*J. Palcont.*
Journal of Parasitology	*J. Parasitol.*
Journal and Proceedings of the Asiatic Society of Bengal	*J. Proc. Asiatic Soc. Bengal*
Journal of the Royal Microscopical Society	*J.Roy microsc. Soc.*
Journal of Science of the Hiroshima University, Series B	*J. Sci. Hiroshima Univ.*, Ser. B.

Journal of the Shimonoseki College of Fisheries	*J. Shimonoseki Coll. Fish.*
Journal of Tropical Medicine and Hygiene	*J. trop. Med. Hyg.*
Journal of the Washington Academy of Science	*J. Wash. Acad. Sci.*
Journal of the Zoological Society of India	*J. zool. Soc. India*
Kansas University Science Bulletin	*Kans. Univ. Sci. Bull.*
Kieler Meeresforschungen	*Kieler Meeresforsch.*
Kongelige Danske Videnskabernes Selskabs Skrifter	*K. danske Vidensk. Selsk. Skr.*
Konelige Norske videnskabernes selskabs forhandlinger	*K. norske Vidensk. Selsk. Forh.*
Kromosomo	*Kromosomo*
Kungliga Svenska vetenskapsakademiens handlingar	*K. svenska Vetenskapsakad. Handl.*
Lavori della Società Malacologica Italiana	*Lav. Soc. malacol. ital.*
Leaflets in Malacology	*Leafl. Malacol.*
Leidsche geologische mededelingen	*Leid. geol. Meded.*
Lethaia	*Lethaia*
Limnologica	*Limnologica*
Los Angeles County Museum of Natural History Contributions in Science	*Los Angeles Co. Mus. natur. Hist. Contr. Sci.*
Malacologia	*Malacologia*
Malacological Review	*Malacol. Rev.*
Malakologische Abhandlungen, Staatliches Museum für Tierkunde in Dresden	*Malakol. Abh., staatl. Mus. Tierk. Dresden*
Malakozoologische Blätter	*Malakozool. Blätt.*
Meddelelser om Grønland	*Medd. Grønland*
Meddelelser fra Kommissionen for Havundersøgelser	*Medd. Komm. Havunders.*
Mémoires de l'Institut royal des sciences naturelles de Belgique	*Mêm. Inst. roy. Sci. natur. Belg.*
Mémoires du Musée royal d'histoire naturelle de Belgique	*Mêm. Mus. roy. Hist. natur. Belg.*
Mémoires du Muséum national d'histoire naturelle	*Mêm. Mus. natn. Hist. natur.*
Mémoires de la Société géologique et minéralogique de Bretagne	*Mêm. Soc. gêol. minêr. Bretagne*
Mémoires de la Société zoologique de France	*Mêm. Soc. zool. Fr.*
Memoirs of the Carnegie Museum	*Mem. Carnegie Mus.*
Memoirs. Cornell University Agricultural Experiment Station	*Mem., Cornell Univ. agr. Exp. Sta.*
Memoirs. Geological Society of America	*Mem., geol. Soc. Amer.*
Memoirs of the Geological Survey Branch, Department of Mines, Canada	*Mem. geol. Surv. Branch, Can.*
Memoirs of the Indian Museum	*Mem. Indian Mus.*
Minutes of the Conchological Club of Southern California	*Minut. conchol. Club s. Calif.*
Miscellaneous Publications of the Museum of Zoology, University of Michigan	*Misc. Publs. Mus. Zool., Univ. Mich.*
Mitteilungen des Badischen Landesvereins für Naturkunde.	*Mitt. bad. Landesver. Naturk.*
Monitore zoologico italiano	*Monitore zool. ital.*
Museum of Zoology, University of Michigan, Circular	*Mus. Zool., Univ. Mich., Circ.*

Natural Science and Museums	*Natur. Sci. & Mus.*
Nature	*Nature*
Naturwissenschaften	*Naturwissenschaften*
Nautilus	*Nautilus*
Netherlands Journal of Zoology	*Neth. J. Zool.*
New Harmony Disseminator of Useful Knowledge	*N. Harmony Dissem. useful Knowl.*
New Zealand Journal of Marine and Freshwater Research	*N.Z. J. mar. freshw. Res.*
Northwest Science	*N.W. Sci.*
Notulae Naturae	*Notulae Natur.*
Nucleus	*Nucleus*
Nyt magazin for naturvidenskaberne	*Nyt Mag. Naturvidensk.*
Occasional Papers of the Bernice P. Bishop Museum	*Occ. Paps. Bernice P. Bishop Mus.*
Occasional Papers on Mollusks	*Occ. Paps. Molls.*
Occasional Papers of the Museum of Zoology, University of Michigan	*Occ. Paps. Mus. Zool., Univ. Mich.*
Oceanography and Marine Biology	*Oceanogr. mar. Biol.*
Oecologia	*Oecologia*
Ohio Journal of Science	*Ohio J. Sci.*
Oikos	*Oikos*
Pacific Science	*Pacif. Sci.*
Palaeontology	*Palaeontology*
Papers of the Michigan Academy of Science, Arts, and Letters	*Pap. Mich. Acad. Sci. Arts & Lett.*
Papua and New Guinea Scientific Society Annual Report and Proceedings	*Papua N. Guinea sci. Soc. ann. Rep. Proc.*
Parasitology	*Parasitology*
Pflügers Archiv für die gesamte Physiologie des Menschen und der Tiere	*Pflügers Arch. ges. Physiol.*
Philosophical Transactions of the Royal Society	*Phil. Trans. Roy. Soc.*
Proceedings of the Academy of Natural Sciences of Philadelphia	*Proc. Acad. natur. Sci. Philad.*
Proceedings of the American Philosophical Society	*Proc. Amer. phil. Soc.*
Proceedings of the Biological Society of Washington	*Proc. biol. Soc. Wash.*
Proceedings of the Boston Society for Natural History	*Proc. Boston Soc. natur. Hist.*
Proceedings of the California Academy of Sciences	*Proc. Calif. Acad. Sci.*
Proceedings of the Egyptian Academy of Sciences	*Proc. Egypt. Acad. Sci.*
Proceedings of the Helminthological Society of Washington	*Proc. helminthol. Soc. Wash.*
Proceedings of the Indiana Academy of Science	*Proc. Indiana Acad. Sci.*
Proceedings of the Iowa Academy of Science	*Proc. Iowa Acad. Sci.*
Proceedings. Koniklijke Nederlandse akademie van Wetenschappen	*Proc. K. ned. Akad. Wetensch.*
Proceedings of the Linnean Society of New South Wales	*Proc. Linn. Soc. N.S.W.*
Proceedings of the Malacological Society of London	*Proc. malacol. Soc. London*
Proceedings of the National Shellfisheries Association	*Proc. natn. Shellfish. Assoc.*

Proceedings of the Oklahoma Academy of Science	*Proc. Okla. Acad. Sci.*
Proceedings of the Pennsylvania Academy of Science	*Proc. Penn. Acad. Sci.*
Proceedings of the Royal Irish Academy	*Proc. Roy. Irish Acad.*
Proceedings of the Royal Society	*Proc. Roy. Soc.*
Proceedings of the Royal Society of Edinburgh	*Proc. Roy. Soc. Edinb.*
Proceedings of the Society for Experimental Biology and Medicine	*Proc. Soc. exp. Biol. Med.*
Proceedings of the United States National Museum	*Proc. U.S. natn. Mus.*
Proceedings of the Utah Academy of Sciences	*Proc. Utah Acad. Sci.*
Proceedings of the Washington Academy of Sciences	*Proc. Wash. Acad. Sci.*
Proceedings of the Zoological Society of London	*Proc. zool. Soc. London*
Professional Papers. United States Geological Survey	*Prof. Paps., U.S. Geol. Surv.*
Public Health Reports	*Publ. Hlth. Reps.*
Publications. Carnegie Institution of Washington	*Publs., Carnegie Inst. Wash.*
Publications of the Seto Marine Biological Laboratory	*Publs. Seto mar. biol. Lab.*
Quarterly Journal of Microscopical Science	*Quart. J. microsc. Sci.*
Record of the Auckland Institute and Museum	*Rec. Auckland Inst. & Mus.*
Record of the Australian Museum	*Rec. Austr. Mus.*
Record of the Dominion Museum	*Rec. Dominion Mus.*
Record of the Indian Museum	*Rec. Indian Mus.*
Record of the South Australian Museum	*Rec. S. Austr. Mus.*
Recueil des travaux de la Station marine d'Endoume, Faculté des sciences de Marseille	*Rec. Trav. Sta. mar. Endoume*
Report. Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History	*Rep., Bernice P. Bishop Mus.*
Report of the Danish Biological Station to the Board of Agriculture	*Rep. Dan. biol. Sta.*
Revista brasileira de biologia	*Rev. bras. Biol.*
Revue suisse de zoologie	*Rev. suisse Zool.*
Revue de zoologie et de botanique africaines	*Rev. Zool. Bot. afr.*
Sarsia	*Sarsia*
Schweizerische medizinische Wochenschrift	*Schweiz. med. Wochenschr.*
Science	*Science*
Scientific Publications. Freshwater Biological Association	*Sci. Publs., Freshw. biol. Assoc.*
Scottish Naturalist	*Scot. Natur.*
Smithsonian Contributions to Knowledge	*Smithson. Contr. Knowl.*
Smithsonian Miscellaneous Collections	*Smithson. misc. Collect.*
South African Journal of Science	*S. Afr. J. Sci.*
Southwestern Naturalist	*Southwest. Natur.*
Special Papers of the Geological Society of America	*Spec. Paps. geol. Soc. Amer.*
Stain Technology	*Stain Technol.*
State Geological Survey of Kansas, Bulletin, University of Kansas Publications	*Geol. Surv. Kans. Bull., Univ. Kans. Publs.*
Sterkiana	*Sterkiana*
Symposia of the Zoological Society of London	*Symp. zool. Soc. London*
Systematic Zoology	*Syst. Zool.*

Tethys	*Tethys*
Tierwelt der Nord- und Ostsee	*Tierwelt N.- u. Ostsee*
Tijdschrift der Nederlandsche dierkundige vereeniging	*Tijdschr. ned. dierk. Ver.*
Tohoku Journal of Agricultural Research	*Tohoku J. agr. Res.*
Torreia	*Torreia*
Transactions of the American Microscopical Society	*Trans. Amer. microsc. Soc.*
Transactions of the Illinois State Academy of Science	*Trans. Ill. St. Acad. Sci.*
Transactions of the Kansas Academy of Science	*Trans. Kans. Acad. Sci.*
Transactions of the Linnean Society of London	*Trans. Linn. Soc. London*
Transactions of the New Zealand Institute	*Trans. N.Z. Inst.*
Transactions of the Royal Society of Edinburgh	*Trans. Roy Soc. Edinb.*
Transactions of the Royal Society of New Zealand	*Trans. Roy. Soc. N.Z.*
Transactions of the Royal Society of Tropical Medicine and Hygiene	*Trans. Roy. Soc. trop. Med. Hyg.*
Transactions of the Wisconsin Academy of Science, Arts, and Letters	*Trans. Wisc. Acad. Sci., Arts & Lett.*
Transactions of the Zoological Society of London	*Trans. zool. Soc. London*
Travaux, Faculté des Sciences, Université de Rennes: Série Océanographie Biologique	*Trav. Fac. Sci. Rennes, Sér. Océanogr. biol.*
Travaux de la Société de pharmacie de Montpellier	*Trav. Soc. Pharm. Montpellier*
Travaux de la Station biologique de Roscoff	*Trav. Sta. biol. Roscoff*
Tromsø museums årshefter	*Tromsø Mus. Årsh.*
Umschau	*Umschau*
University of California Publications in Geological Sciences	*Univ. Calif. Publs. geol. Sci.*
University of California Publications in Zoology	*Univ. Calif. Publs. Zool.*
University of Colorado Studies	*Univ. Colo. Stud.*
University of Kansas Paleontological Contributions	*Univ. Kans. paleont. Contr.*
University of Kansas Publications of the Museum of Natural History	*Univ. Kans. Publs. Mus. natur. Hist.*
Vegetatio	*Vegetatio*
Veliger	*Veliger*
Venus	*Venus*
Verhandlungen der Deutschen Zoologischen Gesellschaft	*Verh. dtsch. zool. Ges.*
Verhandlungen der Zoologisch-botanischen Gesellschaft in Wien	*Verh. zool.-bot. Ges. Wien*
Victoria Naturalist	*Vict. Natur.*
Videnskabelige Meddelelser fra Dansk naturhistorik Forening i Kjøbenhavn	*Vidensk. Medd. dansk naturhist. Foren.*
Vie et milieu	*Vie et Milieu*
Water Resources	*Water Resourc.*
Wilson Bulletin	*Wilson Bull.*
Zeitschrift für Biologie	*Z. Biol.*
Zeitschrift für induktive Abstammungs- u. Vererbungslehre	*Z. indukt. Abstamm.- u. Vererbungsl.*

Zeitschrift für Tropenmedizin und Parasitologie	*Z. Tropenmed. Parasitol.*
Zeitschrift für vergleichende Physiologie	*Z. vergl. Physiol.*
Zeitschrift für Zellforschung und mikroskopische Anatomie	*Z. Zellforsch. mikrosk. Anat.*
Zeitschrift für zoologische Systematik und Evolutionsforschung	*Z. zool. Syst. Evolut.-forsch.*
Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene	*Zentrabl. Bakteriol. Parasitenk.*
Zitteliana	*Zitteliana*
Zoe	*Zoe*
Zoologica	*Zoologica*
Zoologica Africana	*Zool. Afr.*
Zoologicheskiĭ zhurnal	*Zool. Zh.*
Zoologische Beiträge	*Zool. Beitr.*
Zoologische Jahrbücher (Anatomie...)	*Zool. Jahrb. (Anat.)*
Zoologische Jahrbücher (Systematik...)	*Zool. Jahrb. (Syst.)*
Zoologische mededeelingen	*Zool. Meded.*
Zoologischer Anzeiger	*Zool. Anz.*
Zoologiska bidrag från Uppsala	*Zool. Bidr. Uppsala*

Geographical Abbreviations

Countries, territories and major geographical regions, including oceans and seas

Africa	Formosa (Taiwan)
America	France
Arctic	Germany (Deutschland)
Argentina	Great Britain
Asia	Greece
Atlantic	Greenland (Grønland)
Australasia	Hungary
Australia	Iceland
Austria (Österreich)	India
Belgium	Indonesia
Brazil (Brasil)	Iran
Britain	Iraq
British Guiana	Ireland
Bulgaria	Israel
Canada	Italy
Caribbean	Japan
Ceylon	Korea
Chile	Lebanon
China	Liberia
Colombia	Lithuania
Congo	Madagascar
Czechoslovakia	Malaya
Denmark (Danmark)	Malaysia
Deutschland (Germany)	Mediterranean
East Africa	Mexico
Egypt	Mozambique
England	Netherlands (Nederland)
Ethiopia	New Caledonia
Europe	New England
Finland	New Guinea

New Hebrides
New Zealand
Nicaragua
Nigeria
Northern Ireland
North America
North Wales
Norway
Oceania
Pacific
Pakistan
Papua
Philippines
Poland
Portugal
Rhodesia
Rumania (Romania)
Russia
Senegal
Scandinavia
Scotland
South Africa
South America
Spain (España)
Sweden
Switzerland
Taiwan (Formosa)
Trinidad
Turkey
Uganda
Union of Soviet Socialist Republics
United Arab Republics
United Kingdom
United Nations
United States
United States of America
Uruguay
Venezuela
Wales
West Africa
Yugoslavia

States and provinces

Alabama
Alaska
Alberta
Arizona
Arkansas
Bengal
California
Colorado
Connecticut
Delaware
Florida
Georgia
Hawaii
Hiroshima
Hokkaido
Idaho
Illinois
Indiana
Iowa
Kansas
Kentucky
Kyushu
Louisiana
Maine
Manitoba
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
Natal
Nebraska
Nevada
New Brunswick
Newfoundland
New Hampshire
New Jersey
New Mexico
New South Wales
New York
North Carolina
North Dakota
Northern Territory (Austr.)
Northwest Territory (Can.)
Nova Scotia
Ohio
Oklahoma
Ontario
Oregon
Osaka
Pennsylvania
Prince Edward Island
Punjab
Quebec
Queensland
Rhode Island
Saskatchewan
Sonora
South Australia
South Carolina
South Dakota
Tamil Nadu (Madras)

Tasmania
Tennessee
Texas
Transvaal
Utah
Vermont
Victoria
Virginia
Washington
Western Australia
West Virginia
Wisconsin
Wyoming
Yukon Territory

Cities, counties, parishes and districts

Alexandria
Amsterdam
Auckland
Bangkok
Basel
Berlin
Bombay
Bordeaux
Boston
Bremerhaven
Bristol
Brookhaven
Brooklyn
Brussels (Bruxelles)
Budapest
Calcutta
Cambridge
Canberra
Cherbourg
Cheshire
Chicago
Cold Spring Harbor
Copenhagen
Detroit
Drottningholm
Dublin
Edinburgh
Frankfurt am Main
Glasgow
Hamburg
Hiroshima
Kiev
Kyoto
Leeds
Leningrad
Lisbon
Liverpool
London
Los Angeles
Lucknow
Lyon
Madras
Madrid
Manchester
Marseille
Melbourne
Milan (Milano)
Minneapolis
Montevideo
Montreal
Moscow (Moskva)
Munich (München)
Naples (Napoli)
New Delhi
Norfolk
Northumberland
Norwich
Osaka
Ottawa
Paris
Peking
Philadelphia
Pittsburg
Prague (Praha)
Recife
Rome (Roma)
Roscoff
San Francisco
São Paulo
Senckenberg
Seoul
Singapore
Shanghai
Stellenbosch
Stockholm
Stuttgart
Sydney
Tokyo
Toronto
Uppsala
Washington, D. C.
Wien(Vienna)
Woods Hole
Würzburg

MALACOLOGICAL REVIEW, P.O.Box 801, Whitmore Lake, Michigan 48189, U.S.A.

MALACOLOGICAL EVENTS

* * * * * * *

SOCIÉTÉ FRANCAISE DE MALACOLOGIE et SOCIETÀ MALACOLOGICA ITALIANA, SYMPOSIUM.— Sous l'égide de la Societa Malacologica Italiana et de la Société Française de Malacologie, un symposium sera organisé à Lyon entre: Le Samedi 1er et le Lundi 3 Mai 1971. Le sujet retenu - "Mollusques des Alpes" - devrait regrouper, entre autres, un certain nombre de chercheurs particulièrement orientés sur les mollusques d'eau douce qui vivent actuellement dans ce vaste domaine géographique. Il n'est pas exclu de penser que cette réunion soit l'occasion pour les mêmes chercheurs d'évoquer d'autres problèmes, qu'ils soient faunistiques ou paléontologiques. Une excursion est prévue dans la région lyonnaise. Son but serait de faire connaître aux participants les mollusques typiques de quelques formations géologiques récentes, en particulier ceux du loess würmien de la bordure bressane. Les organisateurs lyonnais se chargent bien entendu de la réservation des logements dans les hôtels de la ville. Une liste de ces établissements sera fournie en temps utile à tous les participants. A renvoyer à: Georges Truc, Département des Sciences de la Terre, 86, Rue Pasteur, 69 Lyon 7, France: ou bien Société Française de Malacologie, 55, Rue Buffon, 75 Paris 5, France; ou bien Societa Malacologica Italiana, Museo Civico di Storia Naturale, Viale Piceno 39, Milano, Italia.

WESTERN SOCIETY OF MALACOLOGISTS. - The Fourth Annual Meeting of the Western Society of Malacologists will be held at Asilomar, Pacific Grove, California, U.S.A., from 16-19 June 1971. Symposia and contributed papers will be presented on a wide spectrum of malacological topics.

Inquiries about the meeting should be made no later than May 15th and should be directed to the Secretary, Mrs. Mary D'Aiuto, 804 Fielding Drive, Palo Alto, California 94303. Applications for membership should be directed to the Treasurer, Mr. Ralph O. Fox, Department of Invertebrate Zoology, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118, U.S.A. Dues are US$ 2.50 for Regular Members and US$ 1.00 for Students.

Executive Board members for 1971 are: *President*, Eugene V. Coan; *First Vice-President*, Beatrice L. Burch; *Second Vice-President*, Warren O. Addicott; *Secretary*, Mary D'Aiuto; *Treasurer*, Ralph O. Fox; *Members-at-Large*, Barry Roth and James H. McLean; *Past Presidents*, David K. Mulliner, William K. Emerson and Myra Keen.

UNITAS MALACOLOGICA EUROPAEA, FOURTH EUROPEAN MALACOLOGICAL CONGRESS, 7-11 September 1971. - The 1st circular announcing the Congress has been very favorably received, and it is estimated that some 200 participants and about 100 communications can be expected.

Location of Congress: The Congress will be held at the Museum of Natural History, at the crossing route de Malagnou/rue de Villereuse. The Museum can be reached either by bus No. 1 or 5 from the station, or by bus No. 11 or tramway No. 12.

Secretariate: The secretariate, in the entrance hall of the Museum, will be opened from 6 September at 4 p.m. (Participants to the Curators' Meeting of 6 September will have been received already on 5 September).

Official languages of the Congress: English, French, German.

Communications and discussions: A Congress such as this presents a unique opportunity for meetings between malacologists with different specializations and for exchanging information. It is recommended that the papers read be short and clear, and that the purpose of the research be stated in general terms so that the papers can be followed by malacologists with different backgrounds. Two sessions will be run concurrently. Each speaker will be given 10 minutes. Discussions of papers will take place at later times, mainly in the evenings. Discussions sessions will be held in various places, including conference rooms of the Cité Universitaire.

Abstracts: Authors are requested to send abstracts of their papers as soon as possible, which should be no longer than 20 typewritten lines. These abstracts will be duplicated and distributed to participants. Distribution of abstracts received later than 1 June cannot be guaranteed.

Publication: The proceedings of the Congress will be published, like the former ones, in MALACOLOGIA, the International Journal of Malacology. No paper will be published unless it has been read by its author at the Congress. It will not be sufficient to register for the Congress and send a manuscript or an abstract.

Exhibits: Objects or photographs, in connection with a paper presented to the Congress or not, can be

displayed in a special room of the Museum of Natural History by Museum technicians. These objects, with explanatory texts, should reach the Congress Committee before 1 June. Optical instruments will be provided by the Museum.

Excursions: A half-day excursion by boat on the lake of Geneva, including lunch, will allow Congress participants to meet in pleasant surroundings. A whole-day trip on the Jura will enable participants to discover various biotypes at different levels of altitude.

On the day after the closing of the Congress (provided there is a sufficient number of participants registered), a sight-seeing excursion by coach will travel to the more picturesque and historic sites of the region: the Swiss coast of the lake of Geneva, Chillon castle, lower Wallis, Forclaz mountain pass, Chamonix, with optional ascent by teleferic to Aiguille du Midi (12,600 feet); return to Geneva, through Savoy.

Program for families of participants: In addition to the above mentioned excursions, visits to several museums and to the Old Town will be organized, as well as a bus trip around the canton of Geneva.

Consulting of the Museum's collections: Participants who wish to study specimens in the Museum's collections are requested to notify the Congress Committee in advance, stating the desired time and the systematic groups concerned.

Congress fee: Swiss Francs 30 for members of U.M.E.; S.Fr. 40 for non-members; S.Fr. 15 for students and for accompanying persons. Payable to the banking account mentioned below.

Rates of exchange (February 1971):

S.Fr. 100 = Holl.Fl. 84, Belg.Fr. 115,60, Dan.Cr. 175, DM. 84,5, £ 9,66, L.it. 1460, Fr.Fr. 12,90 Oest.Sch. 604, US$ 23.27.

An exchange office of the International Credit Bank Geneva shall be part of the Secretariate of the Congress.

Hotel reservations: It is urgent to make definite reservations by making a deposit of S.Fr. 50. The Tourist Office can take no responsibility for reservations made after 15 April.

Banking account: All payments are to be made to:
International Credit Bank Geneva
B.P. 377
CH-1211 Geneva 6 Account Nr. 268.049 (Please always quote account number)

Address of Congress: 4ème Congrès de Malacologues Européens
Muséum d'Histoire Naturelle
CH-1211 Geneva 6
Switzerland

SYMPOSIUM ON INDIAN MOLLUSKS AND MALACOLOGY. - A symposium on Indian mollusks and Indian malacology will be held at Porto Novo, Tamil Nadu (Madras) State, India on October 4th, 5th and 6th, 1971. The headquarters of the Symposium will be at the Centre for Advanced study in Marine Biology, Marine Biological Station of Annamalai University, Porto Novo (P.O.). Although research papers will be invited, special emphasis will be placed on reviews of past malacological research, the status of current information, the direction of present work, and desired goals for future research. All aspects of the biology (including palaeontology) of mollusks will be considered.

The Symposium will be sponsored jointly by the Centre for Advanced Study in Marine Biology and the *Society for Experimental and Descriptive Malacology*. The Proceedings will be published in the international journal, *Malacological Review*.

Those interested should contact Prof. R. Natarajan, Director, Marine Biological Station, Porto Novo, Tamil Nadu (Madras) State, India, or Prof. J.B. Burch, Museum of Zoology, The University of Michigan, Ann Arbor, Michigan, U.S.A.

THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND, PROGRAMME OF MEETINGS FOR THE REMAINDER OF 1971. - The final three meetings for 1971 of The Conchological Society of Great Britain and Ireland are scheduled as follows:

North American Land Mollusca. "Some North American land snails," by L. W. Stratton, 16 October 1971.

British Marine Mollusca. "Liverpool Bay - Census Area 24," by L. D. Harfield, 13 November 1971.

Open Exhibition. "A shell collector in the Forces," by P. Cambridge.

Meetings will be held, by permission of the Trustees, at 2:30 P.M. in The Conversazione Room, British Museum (Natural History), Cromwell Road, South Kensington, S.W.7, London, U.K.

Notice of summer *Field Meetings* will appear in the Society's Newsletter.

FIFTH LATIN AMERICAN CONGRESS OF ZOOLOGY. - The Fifth Latin American Congress of Zoology will be held in Montevideo, Uruguay, 18-23 October 1971. One of the sponsors of the Congress is the Sociedad Malacológica del Uruguay, which extends a cordial invitation to attend to all interested malacologists throughout the world. For further information, contact Dr. Miguel A. Klappenbach, Museo Nacional de Historia Natural, Casilla de Correo 399, Montevideo, Uruguay.

FIRST INTERNATIONAL CONGRESS OF SYSTEMATIC AND EVOLUTIONARY BIOLOGY. - The Society of Systematic Zoology and the International Association for Plant Taxonomy have joined forces to develop this first opportunity for botanical/zoological interaction at the international level. The University of Colorado (Boulder, Colorado) has extended a gracious invitation to meet on that campus August 4-11, 1973. The diversity of ecological situations in the surrounding countryside makes this one of the most attractive sites in North America, both aesthetically and scientifically. The presence of experienced, enthusiastic biologists on that campus also provides an indispensable ingredient for the success of this Congress.

To begin the planning phase, 2 committees have been appointed by the sponsoring organizations, a Steering Committee and an International Advisory Committee. The following have been asked to serve on the Steering Committee:

F. A. Stafleu (Chairman), Tweede Transitorium, Uithof, Utrecht, Netherlands
J. O. Corliss (Convenor), Department of Zoology, University of Maryland, College Park, Maryland, U.S.A.
J. L. Reveal (Secretary), Department of Botany, University of Maryland, College Park, Maryland, U.S.A.
R. S. Cowan, National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.
J. A. Peters, Department of Vertebrate Zoology, Smithsonian Institution, Washington, D.C., U.S.A.
R. W. Pennak, Biology Department, University of Colorado, Boulder, Colorado, U.S.A.
W. A. Weber, Natural History Museum, University of Colorado, Boulder, Colorado, U.S.A.
G. S. Daniels (Finance Committee), Hunt Botanical Library, Carnegie-Mellon University, Pittsburgh, Pennsylvania, U.S.A.
P. D. Hurd, Jr. (Co-Chairman of Program Committee), Department of Entomology, Smithsonian Institution, Washington, D.C., U.S.A.
B. L. Turner (Co-Chairman of Program Committee), Department of Botany, University of Texas, Austin, Texas, U.S.A.

The Steering Committee will be the principal organizing group. The International Committee will provide valuable advice and guidance in the development of the Congress and it is recognized by the International Union of Biological Sciences as the special working group responsible for this event.

Program plans at this point encompass interdisciplinary symposia and contributed paper sessions. The botanists will not convene a nomenclatural section but a zoological one on this subject is anticipated. In the next few months the outline of the program and other activities will begin to take form. All suggestions will be gratefully received, carefully considered, and as many adopted as practical or feasible. Correspondence may be addressed to any member of the Steering Committee but preferably to the Secretary: Dr. James L. Reveal, Department of Botany, University of Maryland, College Park, Maryland 20740, U.S.A.

* * * * * * *

MALACOLOGICAL SOCIETIES' NEWS

* * * * * * *

SECOND AUSTRALIAN SHELL COLLECTORS' CONVENTION. - The Second Australian Shell Collector's Convention, sponsored jointly by the Malacological Society of Australia and the Keppel Bay Shell Club was held in Yeppoon, Queensland, Australia 13-18 September 1970. The following papers, as formal lectures were presented during the meetings:

15 September

Moluccas mollusks, B. A. WILSON, *Western Australian Museum, Perth.*

The history of shell collecting on the Great Barrier Reef, J. A. RICHARDSON, *Melbourne.*

Collecting land snails in Tahiti, J. B. BURCH, *University of Michigan, Ann Arbor (U.S.A.).*

Cowry breeding habits, G. LA PRAIK, *Rockhampton.*

Adventures of a marine biologist, R. D. TURNER, *Museum of Comparative Zoology, Cambridge (U.S.A.)*

16 September

The biology of *Tridacna maxima*, a giant clam, D. F. McMICHAEL, *Malacological Society of Australia c/o The Australian Museum, Sydney.*

The Mollusc Section of the Queensland Museum - present and future, H. WILLIAMS, *Queensland Museum, Brisbane.*

Malacology in Victoria, past, present and future, B. J. SMITH, *National Museum of Victoria, Melbourne.*

Over the edge of the shelf, W. F. PONDER; *The Australian Museum, Sydney.*

The evolution of the early gastropods, G. THORNLEY, *Sydney.*

The evolution of the volute genus *Ternivoluta*, T. A. DARRAGH, *National Museum of Victoria, Melbourne.*

17 September

A new approach to the classification of some freshwater snails, J. B. BURCH, *University of Michigan, Ann Arbor (U.S.A.).*

Malacologists attending the Second Australian Shell Collectors' Convention, Yeppoon, Queensland, Australia, 13-18 September 1970. Left to right: J. B. Burch, Philip H. Colman, Anne Paterson, Donald F. McMichael, Barry R. Wilson, Winston F. Ponder, Helen Williams, Brian J. Smith, Ruth D. Turner.

Giant land snails of eastern Australia, D. F. McMICHAEL. *Malacological Society of Australia, c/o The Australian Museum, Sydney.*

The function of a museum, P. H. COLMAN, *The Australian Museum, Sydney.*

Problems in the taxonomy of southern Australian Cowries, B. R. WILSON, *Western Australia Museum, Perth.*

Australian-New Zealand molluscan relationships, W. J. PAUL, *Wellington (N.Z.).*

The biology of marine boring bivalves, R. D. TURNER, *Museum of Comparative Zoology, Cambridge (U.S.A.).*

Other activities included a pre-convention camping trip to North-West Island and a pre-convention dredging trip in Keppel Bay, collecting trips to the Keppel Islands, various coastal sites, and bush areas, shell displays by amateur collectors, slide shows of marine life, a panel discussion by attending scientists, and a final convention banquet.

Malacologists interested in the Australian Malacological Society should contact its Secretary, Mrs. S. White, c/o The Australian Museum, 6-8 College Street, Sydney, N.S.W. 2000, Australia. - J.B.B.

SECOND MEETING OF THE ITALIAN MALACOLOGICAL SOCIETY. - The Second Meeting of the Italian Malacological Society took place on 26-27 September 1970 at the Municipal Museum of Natural History of Genoa. It was held jointly with an international symposium on Ecology of Mediterranean Mollusca. The meetings were attended by 40 national participants and 8 Europeans from France, Germany, Roumania, Spain and Switzerland. An excursion to the nearby Portofino headland was organized on 28 September to observe and collect land and marine Mediterranean Mollusca living in the Genoa Gulf area. This excursion also allowed the many Italian and foreign malacologists an interesting and pleasant meeting to continue to discuss common problems.

The three major reports in the program were: "Factors limiting the production of littoral marine molluscs," by A. FIGUERAS of Vigo, Spain; "Ecology of 'Southern' Helicidae on Mediterranean and Atlantic downs," by C. F. SACCHI of Pavia, Italy; and a "Study on Mollusca before death of Nature," by M. TORCHIO of Milano, Italy. There were also 19 other communications concerning systematics, ecology and zoogeography of both Recent and fossil land, marine and freshwater Mollusca.

Since its initiation 8 years ago (10 January 1963), the Italian Malacological Society has started the publication of its annual "Lavori" (the 1st volume was issued in 1964), held its First Meeting at Verbania-Pallanza in 1966, and organized 2 national symposia in 1969 at Milano and Ispra. - ALBERTO GIROD.

THE ISRAEL MALACOLOGICAL SOCIETY, FIRST ANNUAL SYMPOSIUM. - The first annual meeting of The Israel Malacological Society was held in the Department of Zoology, Tel Aviv University on 11 April 1971. The first (morning) session was presided over by Prof. M. Avnimelech, the second (noon) by Dr. Al. Barash, and the third (evening) session was the annual meeting for members only.

The papers presented at the symposium were:

Dr. Al. Barash & Dr. Z. Danin-Bess - Report on Opistobranchia of the Mediterranean coast and continental shelf.

Dr. Y. Yom-Tov - The biology of the desert snails *Trochoidea* (=*Xerocrassa*) *seetzeni* and *Sphincterochila boissieri*.

D. Dagan - Taxonomic discrimination between certain species of the genus *Theodoxus*.

Dr. E. Tschernov - The freshwater mollusks of the Sinai peninsula.

Dr. E. Tschernov - A new *Pseudamnicola* species from the Dead Sea area, Israel.

Dr. F. Nordsieck - The genus *"Chrysallida"* in the European Seas (including Eastern Mediterranean and Black Sea).

Dr. T. C. Foin & Dr. L. P. Ruebush - The Cypraeidae and the zoogeography of the Red Sea basin.

Summaries of the presented papers will appear in *Argamon*, and the full papers will be published in the *Israel Journal of Zoology*, subtitled "Proceedings of the First Annual Symposium of the Israel Malacological Society."

INSTITUTE OF MALACOLOGY, TENTH ANNUAL MEETING. - The Tenth Annual Meeting of the Sponsor Members of the Institute of Malacology was held on 28 April 1971 at Harvard University, Cambridge, Massachusetts, U.S.A. The presiding officer at the meeting was Dr. N. F. Sohl, President of the Institute of Malacology. Other members in attendance were Drs. K. J. Boss, J. B. Burch, M. R. Carriker, G. M. Davis and R. Robertson. Dr. C. J. Bayne, General Editor of *Malacologia*, also attended.

ANNOUNCEMENTS

* * * * * * *

GRADUATE STUDY IN MALACOLOGY AT THE UNIVERSITY OF MICHIGAN. - National Institutes of Health Predoctoral Traineeships in malacology are available at the Museum and Department of Zoology, The University of Michigan, to qualified U.S. citizens. Participants are expected to pursue graduate studies leading to the Doctor of Philosophy (Ph.D.) degree in Zoology. Active research programs dealing with mollusks include cytology, cytogenetics, cytotaxonomy, genetics, cell, tissue and organ culture, developmental biology, comparative physiology and biochemistry, systematics, natural history, ecology, zoogeography, parasitology and medical zoology. Special emphasis is placed on freshwater mollusks, although aspects of land and marine malacology are also considered. Facilities include well-equipped modern research laboratories for various aspects of biological research. First year stipends are US$ 2400 plus tuition, plus a US$ 500 allowance for each dependent. Address inquiries to the Mollusk Division, Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U.S.A.

The malacology program at the University of Michigan, although involving all levels of college and university training, is directed mainly toward graduate education. Usually students in the program work toward graduate degrees, mostly the Ph.D. degree in Zoology, although some students have received degrees in Natural Resources and Public Health. Most students are in the zoology program since the 3 staff members directing the program are on the Department of Zoology faculty.

The initial course work required of the student in the program is intended to provide a broad background in basic biology. Students can take a wide variety of subjects, which may include such courses as animal geography, biometrics, cytology, developmental biology, ecology, endocrinology, genetics, invertebrate zoology, limnology, parasitology, physiology, systematic and evolutionary biology, etc. The courses required of the student are based on his previous academic course work and experience in zoology, and vary for each student. The intent is to insure that the variety of courses and research experience will qualify the student as a resourceful scientist with a broad academic background. Course work is offered primarily through the Department of Zoology, although cognate work is available through other literary college departments and the departments of the School of Medicine, the Schools of Natural Resources and Public Health, and the Great Lakes Research Division of the Institute of Science and Technology.

In addition to the three staff members directing the program, the malacology unit also has three research associates and eight graduate students. The Mollusk Division consists of ten student and staff office-research rooms, two rooms containing the mollusk shell collections, a room for alcohol-preserved material, three live animal facilities, a pollution-studies laboratory, microtechnique room, physiology-biochemistry laboratory, cytology laboratory and tissue culture laboratory. Two international journals are produced and published in the mollusk unit, *Malacologia* and *Malacological Review*.

VOLUMES, ISSUES AND PUBLICATION DATES OF *MALACOLOGICAL REVIEW*. - *Malacological Review* was first published in one number for the year 1968. This single issue (187 pages) constituted Volume 1. During each of the years 1969 (Volume 2) and 1970 (Volume 3) two semiannual numbers were published, each two issues for a calendar year constituting a volume. Hereafter we intend to continue publishing two issues a year, each formally designated as a "number". The first issue of each volume henceforth will be "Vol.—, No. 1" and the second issue "Vol.—, No. 2". Occasionally, both issues for a calendar year may be combined and designated as "Vol.—, No. 1-2". Each volume will normally consist of about 200 pages, although this may vary from time to time.

Publication dates of past issues are as follows: Vol. 1 - 7 June 1969; Vol. 2 [No. 1], pages 1-102 - 10 June 1969; Vol. 2[No. 2], pages 103-214 - 8 May 1970; Vol. 3 [No. 1], pages 1-102 - 28 May 1970.

NEW SUBSCRIPTION PRICE FOR *MALACOLOGICAL REVIEW*. - Beginning with Volume 5 (1972) the subscription price for institutional orders coming directly from North American institutions (i.e., not through a subscription agency), as well as for all foreign institutions and foreign institutional subscriptions through agencies, will be increased from US$ 5.00 to US$ 8.00 (A$ 7.15, Rs. 60.00, ¥ 2900, E£ 3.5). North American institutional subscriptions handled through subscription agencies will be US$ 9.00 (due to the extra handling required in processing orders). Subscription price for private individuals will remain the same for North American subscribers (US$ 5.00), but subscriptions for non-North American private subscribers will be increased to US$ 5.50 (A$ 4.90, Rs. 42.00, ¥ 2000, E£ 2.5) to defray postage costs.

SUPPLEMENT TO *MALACOLOGICAL REVIEW*, VOLUME 4 (1971). - *Malacological Review* will publish a Supplement to Volume 4, 1971. This supplement is not included in the regular subscription price to *Malacological Review*, but can be purchased separately upon order to the Editors, P. O. Box 801, Whitmore Lake, Michigan 48189, U.S.A., or from the Australian, Egyptian, Indian or Japanese editorial offices. The Supplement is by Emile A. Malek, Tulane University, and is entitled *Freshwater and land snails of St. Lucia, West Indies*. This illustrated publication deals with the systematics, ecology, distribution and faunal relationships of the non-marine mollusks found on the Caribbean island of St. Lucia. Pre-publication price (postpaid) is US$ 2.00, E£ 1, A$ 1.80, Rs. 15.00 or ¥ 720, if payment is received before 1 October 1971. Regular prices (after publication) are US$ 3.00, E£ 1/5, A$ 2.75, Rs. 23 or ¥ 1100 (postpaid).

These Supplements can be ordered from any of the addresses listed below;

MALACOLOGICAL REVIEW
P. O. Box 801
Whitmore Lake,
Michigan 48104
U. S. A.

MALACOLOGICAL REVIEW
c/o Australian Museum
6-8 College Street
P. O. Box A285
Sydney South, Australia

MALACOLOGICAL REVIEW
c/o Mukaishima Marine
Biological Station
Onomichi P. O.
Hiroshima-ken, Japan

MALACOLOGICAL REVIEW
c/o Department of Zoology
Ain Shams University
Abbassia, Cairo
U. A. R.

MALACOLOGICAL REVIEW
c/o Marine Biological Station
of Annamalai University
Porto Novo, Tamilnadu
India

SUPPLEMENT TO *MALACOLOGICAL REVIEW*, VOLUME 5 (1972). - *Malacological Review* will publish a Supplement to Volume 5, 1972, which will not be included in the regular subscription price to *Malacological Review*, but can be purchased upon order to any of the editorial offices listed above. This supplement to Volume 5 is by Gary L. Pace, The University of Michigan, and is entitled *The freshwater mollusks of Taiwan (Formosa)*. This illustrated publication of approximately 200 pages deals with the systematics, ecology, distribution, zoogeography and parasitological relationships of the freshwater gastropod fauna of Taiwan, The Republic of China. Pre-publication price (postpaid) is US$ 10.00, E£ 4/5, A$ 9.00, Rs. 75.00 or ¥ 3600, if payment is received before 1 January 1972. Regular prices (after publication) are US$ 15.00, E£ 6/5, A$ 13.50, Rs. 113 or ¥ 5400 (postpaid).

* * * * * * *

F. A. Schilder

Franz Alfred Schilder

April 13, 1896 - August 11, 1970

Malacological Review, 1971, 4: 49-58

OBITUARY - NACHRUF
FRANZ ALFRED SCHILDER
13. April 1896 - 11. August 1970

Wir deutschen Malakozoologen haben durch den Tod Professor SCHILDER's einen unersetzlichen Verlust erlitten. Er war ein bedeutender Forscher, ein hervorragender Lehrer, ein gütiger, immer hilfsbereiter Mensch.

In seinem Lande wurde er sehr einseitig beurteilt. Wir kannten ihn von seinen ausgezeichneten Vorlesungen her, und jeder seiner Schüler, der ihn jemals um einen Rat gebeten hat, wird bestätigen, dass er immer sein bestes tat, um zu helfen. Manche von uns haben ihm zwar für seinen *Cepaea*-Forschungsauftrag, dessen Ergebnisse in dem Buch "Die Bänderschnecken" (1953/1955) dargestellt sind, Material besorgt. Aber von seinem Hauptwerk, der Arbeit an den Cypraeen, hatten wir nur einen sehr undeutlichen Begriff. Die älteren Kollege bedauerten es sogar, dass er seine glänzenden Gaben an so ein abwegiges Spezialgebiet verwendet hat.

Im Ausland wurde seine Arbeit an den Cypraeen eher nach ihrem Wert geschätzt. Aber dort kannte man wieder nicht den glänzenden geistvollen Redner, den nicht nur gütigen sondern auch heiteren Menschen, der mit seinen Studenten so herzlich lachen konnte.

Von Geburt war er Österreicher. Sein Vater war Dr. jur. FRANZ SCHILDER, kaiserlich österreichischer Beamter in Prag. Dort verbrachte der junge FRANZ ALFRED seine Kindheit und die ersten Schuljahre. Im Jahre 1908 wurde der Vater an das Ministerium in Wien berufen und zog mit seiner Familie dorthin. Am Wiener Gymnasium zu den Schotten legte der Sohn 1914 das Abiturientenexamen ab. Anschliessend begann er, Medizin zu studieren, musste aber 1915 das Studium unterbrechen, da er zum Kriegsdienst eingezogen wurde.

Schon als Schüler hatte er sich für Zoologie interessiert, und besonders hatte er sich mit den Cicindelidae befasst. In den Jahren 1911 und 1912 sind insgesamt 9 entomologische Arbeiten von ihm gedruckt worden. Auch später hat er die Entomologie weiter gepflegt. Sein Interesse für Malakozoologie erwachte erst nach Jahren.

Nach Kriegsende nahm er das Studium wieder auf, belegte aber jetzt die Fächer Ethnographie, Geographie und Paläontologie. Durch seine völkerkundlichen Studien kam er zuerst mit den Cypraeiden in Berührung, das Buch "Muschelgeldstudien" von O. SCHNEIDER weckte sein Interesse, und so wählte er für seine Dissertation das Thema "Porzellanschnecken im Leben der Völker", mit der er 1921 promovierte. Doch hatte er sich auch schon für die Systematik der Gruppe interessiert, denn vor der Druck-Kurzfassung der Dissertation (Wien 1923) erschien in den "Proceedings of the Malacological Society of London" (1922) seine erste malakozoologische Arbeit. In seinem ferneren Leben waren nun die Cypraeen sein Haupt-Interessengebiet.

Der junge Doktor fand seine erste Anstellung im Jahre 1922 am Deutschen Entomologischen Institut in Berlin-Dahlem, blieb dort aber nur ein Jahr. Von dort ging er ans Institut für Hirnforschung der Kaiser-Wilhelm-Gesellschaft (Prof. Dr. VOGT), wo er zwei Jahre blieb. Während der Inflation und danach war für junge Wissenschaftler keine gute Zeit, es war sehr schwer, eine feste Anstellung zu bekommen. Trotzdem heiratete Dr. SCHILDER im Jahre 1924. Seine Frau MARIA, geb. HERTRICH, aus München, war Chemikerin und hatte 1923 in Frankfurt am Main promoviert. Mit der Heirat gab sie ihren Beruf auf und wurde die denkbar beste, unermüdliche und zuverlässige Mitarbeiterin

ihres Mannes. Sie hatten nur eine Tochter FRANZISKA, die leider nicht mehr am Leben ist (1927-1961).

Das Ehepaar fand eine bleibende Statt in Naumburg an der Saale. An der Biologischen Reichsanstalt für Land- und Forstwirtschaft, Zweigstelle für Reblausforschung, hat Dr. SCHILDER von 1925 bis 1947 gewirkt. In seiner Freizeit arbeitete er weiter über Cypraeen, dann auch über Cepaeen. Er begann auch mit Variationsstatistik sowohl an Schnecken als auch an Käfern. Den Urlaub verwandten SCHILDERs für Studienreisen, wobei sie in öffentlichen und privaten Sammlungen des In- und Auslandes rezente und fossile Cypraeiden untersuchten.

Viele Auslandsverbindungen schnitt der zweite Weltkrieg ab, doch arbeiteten sie unentwegt weiter. Nach Kriegsende wurde Dr. SCHILDER an die MARTIN-LUTHER-Universität Halle als Honorarprofessor für Zoogeographie und Biometrie berufen. Zwei Jahre lang hielt er neben seiner Tätigkeit in Naumburg die Vorlesungen in Halle, dann bekam er einen Lehrauftrag und gab deshalb die Anstellung in Naumburg auf. Die ersten Jahre der Professur bedeuteten eine grosse Umstellung von der Forschung auf die Lehre, doch die Hauptschwierigkeit bestand darin, dass im Lande damals moderne wissenschaftliche Literatur kaum zu haben war. Auch an Lehrbüchern für die Studenten fehlte es, und so schrieb er auch einige solche. Später übernahm er noch weitere Vorlesungen, so Genetik und Anthropologie. Alle seine Vorlesungen fanden so grossen Anklang, dass er von der Universität Leipzig gebeten wurde, dort dieselben noch einmal zu halten. Es las also in den Jahren zwischen 1954 und 1963 an zwei Universitäten.

Ausserdem führte er seine malakozoologischen und variationsstatistischen Untersuchungen weiter. Für die Arbeit an den Cypraeen bekam er einen Forschungsauftrag, so dass er dafür auch Mittel bekam und daran im Rahmen seiner Dienstobliegenheiten arbeiten konnte. Die Arbeit an den Cypraeen blieb sein Freizeit-Interesse.

Im Jahre 1962 ging er in den Ruhestand. Er litt an Herzasthma, hielt aber seine Vorlesungen in Halle noch bis 1966. Allerdings gab er dann die Beschäftigung mit Insekten und anderen Tiergruppen auf und widmete sich nur noch den Cypraeen. Weil er seine Kräfte nachlassen fühlte, gab er seine Einzelergebnisse immer schnell in Druck und nahm die grosse Cypraeidenmonographie, die ihm vorgeschwebt hatte, nicht mehr in Angriff. Doch schrieb er als abschliessende Arbeit mit seiner Frau zusammen: "A Catalogue of living and fossil Cowries (Nomenclature and Bibliography of Cypraecea and Triviacea)," die in Brüssel im Mém. Inst. Roy. Sci. nat. Belgique, 2. ser. fasc. 85 erscheinen wird.

Seine Bibliographie umfasst insgesamt über 400 Titel, grosse und kleinere Arbeiten, im ganzen eine gewaltige Leistung. In seinen Veröffentlichungen hat er 45 Genera und 483 Species und Subspecies neu aufgestellt.

Ihm zu Ehren wurden benannt: Die Gattung *Schilderia* TOMLIN 1930, die rezente Art *Lyncina schilderorum* IREDALE 1939, die fossile Art *Zoila schilderi* DEY (1932) 1941, die Rasse *Cypraea tigris schilderiana* CATE 1961.

Er gehörte der Deutschen Zoologischen Gesellschaft, der Deutschen Malakozoologischen Gesellschaft, der Malacological Society of London und der Conchological Society of Great Britain and Ireland als Mitglied an, der Hawaiian Malacological Society und dem Keppel Bay Shell Club als Ehrenmitglied.

Seine Forschungsarbeit kann in der DDR nicht fortgesetzt werden. Frau Dr. MARIA SCHILDER ist nur wenig jünger als ihr verstorbener Mann; einen persönlichen Schüler, den sie in die Kenntnis der Cypraeen hätten einführen können, haben sie nicht gehabt.

* * * * * * *

German Malacology has lost one of its most prominent experts, Prof. Dr. F. A. Schilder, Hall/Saale. He was a gifted and verstaile researcher, an outstanding lecturer, a true and helpful friend and a father to his students.

In his own country hardly anyone knew of Prof. Schilder's important work on the Cypraeidae. Many of his colleagues even regretted that he "wasted his brilliant gifts on an obstruse subject." Abroad, however, he was appreciated more justly.

Prof. Schilder, born in Prague, was the son of Franz Schilder, Jur. D., an Austrian officer. In 1908 the family moved to Vienna. As a schoolboy he was already interested in zoology. His first was entomology and at the age of 14 he published his first papers on the beetle Family Cincindelidae. In 1914 he began to study medicine, but was soon called to war service. After release from service he chose to study ethnography, geography and paleontology. He first became acquainted with the Cypraeidae in connection with ethnology, and it was with a thesis on the use of cowries that he obtained the degree of Doctor of Philosophy in 1921 at the University of Vienna.

From Vienna young Dr. Schilder moved to Berlin. In those years of inflation he had to move several times, until in 1925 he was appointed at Naumburg/Saale at the Institute for combating the vine-louse (*Phylloxera*), where he worked until 1947. He had married Dr. Maria Hertrich from Munich, a chemist, who shifted her interests completely to the study of cowries. She was his best and most reliable collaborator. They devoted all their spare time to cowries.

After World War II Dr. Schilder became professor of zoology at the University of Halle. At first, while continuing his work at Naumburg, he lectured in zoogeography and biometry only. After 1947 he also lectured on genetics and anthropology and moved to Halle. As his lectures were very popular, the university of Leipzig asked him to repeat them. He thus taught at both Universities from 1954 to 1963. Although he officially retired in 1962, he lectured until 1966. In his last years he worked nearly exclusively with cowries.

Prof. Schilder's publications comprise more than 400 titles of papers and books: entomological, malacological, subjects on which he lectured and even compendia for his students. The summary and conclusion of his lifework on Cypraeidae, *"A Catalogue of living and fossil cowries (nomenclature and bibliography of Cypraeacea and Triviacea)"* will be printed in Brussels. He has named 45 genera and 483 species and subspecies, and several taxa have been named after him. German and foreign scientific societies, especially malacological societies, have elected Prof. Schilder to their membership or honorary membership.

Prof. Schilder's work with Cypraeidae unfortunately will not be continued in our country. Dr. Maria Schilder is not much younger than her husband, and they they have had no students to carry on the work.

HILDEGARD ZEISSLER

Institut für Quartärpaläontologie
Weimar
German Democratic Republic

Malakologische Schriften von FRANZ ALFRED SCHILDER

1922 Contributions to the knowledge of the genera *Cypraea* and *Trivia*. *Proc. malacol. Soc. London*, 15: 98-122.
1923 Die Porzellanschnecken im Leben der Völker. *Verh. zool.-bot. Ges. Wien*, 72: 135-136.
- Über die Bändervariationen unserer *Cepaea*-Arten. *Arch. Molluskenk.*, 55: 63-72.
- Bemerkungen zu einigen fossilen *Cypraea*-Arten. *Senckenbergiana*, 5: 96-100.
- Drei neue miozäne *Cypraea*-Arten. *Senckenbergiana*, 5: 100-107.
- *Cypraea vinosa* Gmel. in Geschichte und Urgeschichte. *Arch. Molluskenk.*, 55: 204-206.
1924 Kritisches Verzeichnis der rezenten und fossilen Cypraeen. *Abh. Arch. Molluskenk.*, 1(2): 1-192.
- Systematischer Index der rezenten Cypraeidae. *Arch. Naturgesch.*, 90A(4): 179-214.
- Zur Verwendung der Porzellanschnecken. *Kosmos*, 21(7): 209-210.
- Systematisches Verzeichnis der lebenden Cypraeidae. *Arch. Molluskenk.*, 56: 234-237.
1925 Schnecken der Venus. *Umschau*, 29(19): 369-370.
- Die Abänderungen der Hain- und Gartenschnecke. *Kosmos*, 22(9): 313-315.
1926 Zur Variabilität von *Capaea* (Mollusca). *Z. indukt. Abstamm.-u. Vererbungsl.*, 39(3-4): 249-280.
- Die Königin der Porzellanschnecken. *Naturfr. Detmold*, 3: 176-177.
- Die ethnologische Bedeutung der Porzellanschnecken. *Z. Ethnol.* 1926: 313-327.
- Additions and corrections to Vredenburg's classification of the Cypraeidae. *Rec. geol. Surv. India*, 58(4): 358-379.
- An interesting radula (*Eocypraea adamsoni* Sow.). *Nautilus*, 40: 17-18.
1927 Three new varieties of *Cypraea*. *Nautilus*, 40: 126-129.
- Revision der Cypraeacea (Mollusca: Gastropoda). *Arch. Naturgesch.*, 91A(10): 1-171.
- Synopsis der Cypraeacea fossiler Lokalfaunen. I. Der Kressenberg. *Senckenbergiana*, 9: 196-222.
1928 Die Cypraeacea des Daniums von Dänemark und Schonen. *Danm. Geol. Undersø.*, 4(2-3): 1-29. [=Synopsis der Cypraeacea fossiler Lokalfaunen 2.]
- Die Variabilität der Schalenlänge der Cypraeidae (Mollusca: Gastropoda). *Zool. Anz.*, 79(1-2): 5-21.
- Eine wenig bekannte Cypraeiden-Art. *Arch. Molluskenk.*, 60: 193-195.
- Synopsis der Cypraeacea fossiler Lokalfaunen. 3. Das Mittel-Oligozän von Weinheim bei Alzey. 4. Das Jungtertiär von Gran Canaria. *Senckenbergiana*, 10: 264-285.
1929 Synopsis der Cypraeacea fossiler Lokalfaunen. 5. Das Tertiär Norddeutschlands. *Mitt. Mineral. Geol. Staatsinst. Hamburg*, 11: 7-20.
- Gesetzmässigkeiten und Ursachen der Schalenvariabilität bei Cypraea. 10è *Congr. intern. Zool., Budapest.* p 980-990.
- [Mit Maria Schilder] Eine Ausbeute von Cypraeacea aus Port Alfred. *Ann. Natur. Mus. Wien*, 43: 229-241.
- Namensänderungen bei Cypraeacea. *Arch. Molluskenk.*, 61: 285-287.
- Beiträge zur Kenntnis der Cypraeacea (Mollusca: Gastropoda). 1. Eine Bestätigung der Bergmann-schen Regel. 2. Ein Nachtrag zum *Zool. Anzeiger* 79, p 19-21 (1927). 3. Die Korrelation der Basis-flecke bei *Pustularia*. 4. *Erronea* (*Erronea*) *vredenburgi* Schilder. *Zool. Anz.*, 85(5-8): 130-137.
- The Eocene Amphiperatidae and Cypraeidae of England. *Proc. malacol. Soc. London*, 18(6): 298-311.
1930 Beiträge zur Kenntnis der Cypraeacea (Mollusca: Gastropoda). II. 5. Die Ringflecke von *Callistocypraea argus* (Linn.). 6. Eine fast unbekannt gebliebene Veröffentlichung. 7. Zwei interessante neue Cypraeidae. 8. Neue Zeichnungsvarietäten von phylogenetischer Bedeutung. *Zool. Anz.*, 87 (3-6): 109-118.
- Remarks on the type specimens of some recent Cypraeidae. *Proc. malacol. Soc. London*, 19(1): 49-58.
- Missbildungen an Schalen der Cypraeacea (Mollusca: Gastropoda). *Z. Morphol. Ökol. Tiere*, 19(1): 144-159.
- Beiträge zur Kenntnis der Cypraeacea (Mollusca: Gastropoda). III. 9. Die Beziehungen zwischen Schalenlänge und Zahnzahl. 10. Das Genus *Triviella* Jouss. (1884). 11. Zur Rassenbildung der Cypraeidae. *Zool. Anz.*, 92(3-4): 67-78.
- [Mit Maria Schilder] Variationsstatistische Studien an *Monetaria annulus* (Mollusca: Gastropoda: Cypraeidae). *Mitt. zool. Staatsinst. Mus. Berlin*, 16(3): 543-565.
- The Gisortiidae of the world. *Proc. malacol. Soc. London*, 19(3): 118-138.
1931 Zwei neue *Trivia* (Cypraeacea: Eratoidae). *Arch. Molluskenk.*, 63: 42-44.
- [Mit Maria Schilder] Cypraeidés de la côte d'Aden. *Bull. Soc. zool. France*, 56: 211-217.
- Die Cypraeacea des Eozän von Belgien. *Bull. Mus. Hist. natur. Belg.* 7(14): 1-23.
- Die Korrelation zwischen Grösse und Zahnzahl bei den Cypraeidae (Mollusca). *Arch. zool. ital.* 16: 219-222.
- Beiträge zur Kenntnis der Cypraeacea (Mollusca: Gastropoda). IV. 12. Weinkauff's Typen im Loebbecke-Museum. 13. Die Gruppe von *Erronea fimbriata* (Gmel.). 14. Neue und alte Triviinae. *Zool. Anz.*, 96(3-4): 65-72.

- Trois Amphiperatidae nouveaux. *Bull. Soc. zool. France*, 56: 364-367.
- [Mit J. R. Tomlin] Rediscovery of a rare cowry. *Proc. malac. Soc. London*, 19(6): 274-275.
- Fossile Cypraeidae von Obersuld (Berner Oberland). *Mitt. naturforsch. Ges. Bern*, p 81-91.
- Revision of the subfamily Pediculariinae. *J. Conchol.*, 19(6): 165-169.

1932 The living species of Amphiperatinae. *Proc. malacol. Soc. London*, 20(1): 46-64.
- Revisione delle Cypraeacea fossili del Piemonte e della Liguria: 1. Liguria. 2. Piemonte. *Riv. Ital. de Paleont.*, 38: 9-18, 19-52.
- Les Cypraeacea fossiles du Département des Bouches-du-Rhône. *Ann. Mus. Hist. nat. Marseille*, 24: 87-90.
- Neue fossile Cypraeacea (Mollusca: Gastropoda). *Sitzungsber. Ges. Naturforsch. Freunde Berlin*, p 254-269.
- Cypraeacea. *In:* Quenstedt, W. *Fossilium Catalogus*, 1(55): 1-276.
- Beiträge zur Kenntnis der Cypraeacea (Mollusca: Gastropoda). V. 15. Cypraeidae von den südlichen Marianen. 16. Die Radula einiger bisher nur als Schalen bekannter Arten. 17. Über einige sehr seltene Cypraeidae. *Zool. Anz.*, 100(7-8): 164-173.
- Une coquille rare du Muséum d'Histoire Naturelle (*Trivirostra corinnae* Shaw). *Bull. Soc. zool. France*, 57: 399-401.

1933 Beiträge zur Kenntnis der Cypraeacea (Mollusca: Gastropoda). VI. 18. Länge, Proportionen und Bezahnung der Cypraeidae. *Zool. Anz.*, 101(7-8): 180-193.
- Cypraeacea from Hawaii. *Occ. Pap. Bishop Mus.*, Honolulu 10(3): 1-22.
- Beiträge zur Kenntnis der Cypraeacea (Mollusca: Gastropoda). VII. 19. Das Genus *Trivirostra* Jouss. 20. Cypraeacea von Neu-Pommern. *Zool. Anz.*, 102(11-12): 288-303.
- Die Cypraeacea des Pliocän und des Wemmelien von Belgien. *Bull. Mus. Hist. nat. Belg.*, 9(9): 1-28.
- Monograph of the subfamily Eratoinae. *Proc. malacol. Soc. London*, 20(5): 244-283.
- A new dwarf race in Cypraeidae. *J. Conchol.*, 19(11): 355-357.
- [Mit Maria Schilder] Die Cypraeidae von Niederländisch Ost-Indien. *Zool. Meded.*, Leiden 16(3-4): 163-205.

1934 [Mit J. R. Tomlin] Reports on the marine Mollusca in the collections of the South African Museum. *Ann. S. Afr. Mus.*, 30(3): 477-479.
- The variability of colour in *Monetaria annulus*. *Proc. malacol. Soc. London*, 21(2): 92-95.
- [Mit Maria Schilder] Thirteen thousand Cypraeidae from South Java. *Proc. malacol. Soc. London*, 21(3): 199-213.
- [Mit Maria Schilder] *Cardium edule* bei Warnemünde. *Arch. Molluskenk.*, 66(6): 358-360.

1935 [Mit Maria Schilder] Variationskurven der Schalenlänge von Cypraeacea. *Arch. Molluskenk.*, 67: 135-143.
- [Mit Maria Schilder] Lage und Breite der Bänder von *Cepaea*. *Arch. Molluskenk.*, 67: 144-151.
- Revision of the Tertiary Cypraeacea of Australia and Tasmania. *Proc. malacol. Soc. London*, 21(6): 325-355.

1936 Some interesting monstrosities in Cypraeidae. *J. Conchol.* 20(7): 222-223.
- Anatomical characters of the Cypraeacea which confirm the conchological classification. *Proc. malacol. Soc. London*, 22(12): 75-112.
- Zwei interessante fossile Cypraeacea aus Indien (Mollusca: Gastropoda). *Ing. Ned. Indië*, 4(3)12: 207-209.

1937 [Mit Maria Schilder] Revision of the genus *Monetaria*. *Proc. zool. Soc. London*, p 1113-1135.
- [Mit Maria Schilder] Die Cypraeidae des Bismarckarchipels. *Zool. Anz.*, 119(7-8): 177-194.
- Two significant discoveries in Cypraeidae. *Proc. malacol. Soc. London*, 22(6): 367-370.
- Neogene Cypraeacea aus Ost-Java (Mollusca: Gastropoda). *Ing. Ned. Indië*, 4(4)11: 195-210.

1938 [Mit Maria Schilder] Description of two new cowries. *Proc. malacol. Soc. London*, 23(3): 114-115.

1938-39 [Mit Maria Schilder] Prodrome of a monograph on living Cypraeidae. *Proc. malacol. Soc. London*, 23(3): 119-180. (1938) 23(4): 181-231 (1939).

1939 Länge, Breite und Zahnzahl der Cypraeidae. *Arch. Molluskenk.*, 71: 75-82.
- Die Genera der Cypraeacea. *Arch. Molluskenk.*, 71: 165-201.
- Über einige fossile Cypraeacea aus dem Sunda-Archipel. *Neues Jahrb. Mineral.*, 81B: 491-500.
- Cypraeacea aus dem Tertiär von Trinidad, Venezuela und den Antillen. *Abh. Schweiz. Palläontol. Ges.*, 62: 1-35.

1940 [Mit Maria Schilder] Die Verbreitung und Häufigkeit der rezenten Cypraeidae. *Arch. Molluskenk.*, 72: 33-55.
- [Mit Maria Schilder] Die Bestimmung der relativen Häufigkeit einer Art. *Arch. Molluskenk.*, 72: 160-169.

1941 Verwandtschaft und Verbreitung der Cypraeacea. *Arch. Molluskenk.*, 73: 57-120.
- The marine Mollusca of the Kendeng Beds (East Java). Gastropoda, part 3. *Leid. Geol. Meded.*, 12 (1): 171-194.

1942 Der Formenreichtum der Cypraeacea im Laufe der Erdgeschichte. *Arch. Molluskenk.*, 74: 98-103.

- Der Wandel des Formenreichtums der Cypraeacea (Mollusca: Gastropoda) im Laufe der Erdgeschichte. *Sitzungsber. Ges. Naturforsch. Freunde Berlin*, 1942: 77-94.
- Statistische Untersuchungen an Populationen. *Arch. Molluskenk.*, 74: 129-142.
- Cypraeacea della Creta superiore della Libia (Mollusca: Gastropoda: Prosobranchia). *Ann. Mus. Libico, Storia Nat.*, 3: 53-73.

1943 Zur Verwandtschaft der Litoralfaunen. *Arch. Molluskenk.*, 75: 68-82.

- Untersuchungen an den Jungendformen der Cypraeiden-Schalen. *Arch. Molluskenk.*, 75: 201-204.

1944 [Mit Maria Schilder] Westpazifische Cypraeacea von den Forschungsreisen des Prof. Dr. Sixten Bock. *Ark. Zool.*, 36A(2): 1-32.

1947 Die Zahl der Prosobranchier in Vergangenheit und Gegenwart. *Arch. Molluskenk.*, 76: 37-44.

- Zur Variabilität von *Blasicrura ursellus* (Gmelin). *Arch. Molluskenk.*, 76: 37-44.
- [Mit Maria Schilder] Zur Entwicklung der Molluskenkunde. *Arch. Molluskenk.*, 76: 163-166.
- Die Cypraeacea im Lichte der Fromenkreislehre. *Arch. Molluskenk.*, 76: 169-189.

1949 Statistical notes on malacology. *Proc. malacol. Soc. London*, 27(6): 269-271.

- [Mit Maria Schilder] Studien zur Verbreitung der Meeresmollusken. *Arch. Molluskenk.*, 77: 53-62.
- The variation of banding in *Cepaea*. *Nautilus*, 62: 116.

1950 Die Ursachen der Variabilität bei *Cepaea*. *Biol. Zentralbl.*, 69(3-4): 79-103.

1951 Berichtigte Klassifikation der unteroligozänen Cypraeacea von Mitteldeutschland. *Hallesch. Jahrb. Mitteld. Erdgesch.*, 1(3): 180-181.

1952 [Mit Maria Schilder] *Bitte um Mitarbeit an einem wichtigen Problem der Evolution*. Selbstverlag. Halle. 12 p.

- [Mit Maria Schilder] Probleme um unsere Bänderschnecken. *Urania*, 15(5): 195-200.
- [Mit Maria Schilder] Junge Biologen, helft der Wissenschaft. *Der Junge Pionier*, 5(27).
- [Mit Maria Schilder] Ph. Dautzenberg's collection of Cypraeidae *Mém. Inst. R. Sci. nat. Belg.*, (2) 45: 1-243.

1953 Zum Polymorphismus bei *Cepaea*. *Verh. Deut. zool. Ges. Freiburg*, p 487-492.

- [Mit Maria Schilder] Nochmals über *Cepaea interrupta* Moquin-Tandon. *Arch. Molluskenk.*, 82: 71-75.
- [Mit Maria Schilder] *Die Bänderschnecken. I. II. Eine Studie zur Evolution der Tiere*. Jena. 92 p.

1955 [Mit Maria Schilder] Zum Problem des Zusammenlebens nahe verwandter Tierarten. *Wiss. Z. Univ. Halle*, Math. Nat., 4(5): 941-976.

1957 Biometrische Studien an Porzellanschnecken. *Wiss. Z. Univ. Halle*, Math. Nat., 6(1): 97-116.

- Sechsjährige Konstanz einer Population von *Cepaea nemoralis*. *Arch. Molluskenk.*, 86: 33-36.
- Die mitteltertiären *Cepaea* des Mainzer Beckens. *Arch. Molluskenk.*, 86: 37-40.
- Die Bergmannsche Regel bei Porzellanschnecken. *Verh. dtsch. zool. Ges. Hamburg*, 1956: 410-414.
- [Mit Maria Schilder] *Die Bänderschnecken III*. p 93-206, Jena.

1958 [Mit Maria Schilder] Biometrische Studien an Porzellanschnecken II. *Wiss. Z. Univ. Halle*, Math Nat., 7(1): 63-80.

- Eine fast unbekannte Schnecke der Hawai-Inseln. *Veröff. Übersee-Mus. Bremen*, A. 3(1): 32-38.
- Versuch einer genetischen Klassifikation bei Bänderschnecken (*Cepaea*). *Systematics of to-day, Uppsala Univ. Arsskr.*, 1956(6): 169-175.
- Die Bezeichnung der Zahndichte der Cypraeacea. *Arch. Molluskenk.*, 87: 77-80.
- Über drei seltene Cypraeacea. *Arch. Molluskenk.*, 87: 81-87.
- [Mit Maria Schilder] Nochmals zur Konstanz der *Cepaea*-Populationen. *Arch. Molluskenk.*, 87: 89.
- Die Typen der von mir benannten Cypraeacea. *Arch. Molluskenk.*, 87: 157-179.

1959 Neue Gesetzmässigkeiten bei der Rassenbildung der Porzellanschnecken. *Verh. dtsch. zool. Ges. Frankfurt a. M.*, 1958: 404-406.

- Regional convergence of shell characters in Cypraeidae (Mollusca). *Proc. 15th Int. Congr. Zool., London*, 1958, p 186-190.

1960 The cowries of Mauritius. *Proc. malacol. Soc. London*, 34(1): 52-53.

- [Mit Maria Schilder] Geschlecht, Radula und Schale der Porzellanschnecken. *Naturwiss.*, 47(13): 309-310.
- Zur Kenntnis der Cypraeidae 1-2. *Arch. Molluskenk.*, 89: 185-192.

1961 Beziehungen zwischen Geschlecht, Radula und Schale bei den Porzellanschnecken. *Zool. Anz.* (Suppl.), 27: 395-398.

- [Mit Maria Schilder] Sexual differences in cowries. *Proc. malacol. Soc. London*, 34(4): 207-209.
A statistical study in cowries: The size of *Mauritia arabica* (Linnaeus) *Veliger*, 4(1): 15-17.
- [Mit Maria Schilder] Zur Kenntnis der Cypraeidae. 3. Länge und Reihenzahl der Radula. *Arch. Molluskenk.*, 90: 33-42.
- Another statistical study in size of cowries. *Veliger*, 4(2): 107-112.
- Nachträge zum Katalog der Cypraeacea von 1941. *Arch. Molluskenk.*, 90: 145-153.
- [Mit Maria Schilder] Zur Variabilität der Zeichnungselemente bei Porzellanschnecken (Cypraeidae). *Zool. Anz.*, 167(6-7): 303-309.

1962 Type localities. *Veliger*, 4(4): 199-202.
- Zoogeographische Probleme der Porzellanschnecken im Lichte der Phylogenie. *Zool. Anz.* (Suppl.) 25: 495-498.
- [Mit Maria Schilder] Zur Kenntnis der Cypraeidae. 4. Geschlechtsunterschiede bei *Monetaria moneta*. *Arch. Molluskenk.*, 91: 99-103.
- [Mit R. S. Benton] Studies on *Erosaria lamarckii* Gray. *Veliger*, 5(1): 30-32.
- Hybrids between *Cypraea tigris* Linnaeus 1758 and *Cypraea pantherina* Solander 1786. *Veliger*, 5(2): 83-87.
- [Mit Maria Schilder] Zur Kenntnis der Cypraeidae. 5. Eine neue Riesenform aus Ostafrika. *Arch. Molluskenk.*, 91: 207-212.

1963 [Mit Maria Schilder] Statistical studies on cowrie radulae. *Veliger*, 5(3): 106-111.
- Further remarks on two rare cowrie species (Gastropoda). *Veliger*, 5(4): 125-128.
- [Mit Maria Schilder] Cowrie populations from Kenya (Mollusca: Gastropoda). *Veliger*, 5(4): 149-156.
- Discontinuous distribution in cowries. *Amer. malacol. Union ann. Reps.*, 30: 40.
- An abnormal cowry radula. *Proc. malacol. Soc. London*, 35(4): 129-130.
- Zur Kenntnis der Cypraeidae. 6. Über zwei seltene Arten aus Japan. *Arch. Molluskenk.*, 92: 123.
- Lumpers and splitters. *Veliger*, 6(2): 104-110.

1964 [Mit Maria Schilder & G. Houston] The cowry fauna of Penrith Island (Mollusca: Gastropoda). *Veliger*, 6(3): 155-161.
- Errata (in the Cowry fauna...) *Veliger*, 6(4): 230.
- [Mit Maria Schilder] The cowrie *Mauritia eglantina* (Duclos 1833) in Fiji. *Veliger*, 6(4): 221-226.
- Provisional classification of the genus *Notocypraea* Schilder 1927 (Cypraeidae). *Veliger*, 7(1): 37-43.
- [Mit R. P. Scase] New observations on *Erronea vredenburgi* Schilder (Cypraeidae). *J. Conchol.*, 25(6): 231-233.
- [Mit Maria Schilder] Studies in Variation of Cowries: The basal blotches of *Talparia argus* (Linn.). *J. Conchol.*, 25(6): 234-235.
- Zur Kenntnis der Cypraeidae. 7. Eine neue *Notadusta* aus Melanesien. *Arch. Molluskenk.*, 93: 141-144.
- The cowries established by Coen in 1949. *Veliger*, 7(2): 103-107.
- Zur Kenntnis der Cypraeidae. 8. Eine neue *Erronea* aus Queensland. *Arch. Molluskenk.*, 93: 211-214.

1965 The geographical distribution of cowries (Mollusca: Gastropoda). *Veliger*, 7(3): 171-183.
- [Mit W. O. Cernohorsky] A new cowries race from North West Australia. *Veliger*, 7(4): 225-227.
- A statistical study in fossil cowries. *Veliger*, 7(4): 236-240.
- Zur Kenntnis der Cypraeidae. 9. Eine zweite Überraschung aus Queensland. *Arch. Molluskenk.*, 94: 55-60.
- The cowry fauna of Thailand. *Veliger*, 8(1): 23-28.
- Israel South Red Sea Exped. 1962, Rep. No. 16: Cypraeidae. *Sea. Fish Res. Sta. Haifa*, 40: 75-78.
- Zur Kenntnis der Cypraeidae. 10. Eine dritte Beziehung der Faunen von Australien und Japan. *Arch. Molluskenk.*, 94: 147-149.

1966 Personal views on Taxonomy. *Veliger*, 8(3): 181-189.
- [Mit Maria Schilder] The size of ninety-five thousand cowries. *Veliger*, 8(4): 208-215.
- [Mit Maria Schilder] Dimorphism and monstrosities in cowrie radulae. *Veliger*, 8(4): 215-221.
- The type localities of living Cypraeidae. *Malakol. Abh. Staatl. Mus. Tierk. Dresden*, 2(14): 193-233.
- *Mauritia mauritiana* (L.) at Aden. *J. Conchol.*, 26(1): 66-68.
- The higher taxa of cowries and their allies. *Veliger*, 9(1): 31-35.
- [Mit Maria Schilder] Statistics in North-West America *Pusula jousseaume* (Triviidae). *J. Conchol.*, 26: 131-134.
- Zur Kenntnis der Cypraeidae. 11. Noch eine Beziehung der Faunen von Australien und Japan. *Arch. Molluskenk.*, 95: 157-160.
- Linnaeus' type specimens of cowries. *Veliger*, 9(2): 91-100.
- Neue fossile Cypraeacea und Triviacea aus Australien. *Arch. Molluskenk.*, 95: 296-274.

1967 Intraspecific evolution in *Blasicrura interrupta* Gray. *Veliger*, 9(3): 292-297.
- Note on *Pusula darteveliei* Knudsen 1955. *Rev. Zool. Bot. Afr.*, 75(1-2): 71-76.
- Zur Kenntnis der Cypraeidae. 12. Eine aberrante *Notadusta* aus Sydney. *Arch. Molluskenk.*, 96: 39-41.
- Cypraeidae from New Zealand. *Rec. Auckl. Inst. Mus.*, 6(3): 201.
- [Mit Maria Schilder] Studies on East Australian cowries. *Veliger*, 10(2): 103-110.
- Neue Triviidae und Ovulidae aus Westafrika. *Arch. Molluskenk.*, 96: 195-198.

1968 The generic classification of cowries. *Veliger*, 10(3): 264.
- [Mit Maria Schilder] Eine Population von *Trona stercoraria* (Linn.). *Ann. Naturhist. Mus. Wien*, 70: 245.
- [Mit C. N. Cate] A new cowrie species from the Philippines. *Veliger*, 10(4): 382.
- Zur Kenntnis der Cypraeidae. 13. Eine Mutation von *Erronea errones* (Linnaeus). *Arch. Molluskenk.*, 98: 73-75.
- A cowrie mutant from the Gulf of Thailand. *Veliger*, 11(1): 34.
- [Mit Maria Schilder] Studies on populations of the cowrie *Erronea errones* (Linn.). *Veliger*, 11(2): 109.
- [Mit Maria Schilder] Statistics of a population of *Erosaria spurca* (L.). *J. Conchol.*, 26: 305.

1969 Zoogeographical studies in living cowries. *Veliger*, 11(4): 367-377.
- Repertorium der Radulae der Triviacea und Cypraeacea. *Arch. Molluskenk.*, 99: 91-106.
- Eine neue *Phenacovolva* aus Südafrika. *Arch. Molluskenk.*, 99: 209-211.

Im Druck: [Mit Maria Schilder] A Catalogue of living and fossil cowries. Taxonomy and Bibliography of Triviacea and Cypraeacea (Gastropoda: Prosobranchia) *Mém. Inst. roy. Sci. nat. Belgique*, 2. sér. fasc. 85.

Aufsätze von FRANZ ALFRED SCHILDER, die in vervielfältigten "Newsletters" erschienen sind

1960 Intraspecific Taxonomy. The Cowry, 1(1): 8.
1961 New cowries described since 1938. The Cowry, 1(2): 1-5.
1962 [Mit R. J. Griffiths] A new Polynesian cowry. The Cowry, 1(3): 34.
- Note on *Bistolida luchuana* Kuroda. The Cowry 1(3): 39.
- [Mit Maria Schilder] The size of *Cypraea tigris*. The Cowry, 1(3): 43-44.
- [Mit Maria Schilder] Sex and size. The Cowry, 1(4): 50-52.

1963 [Mit R. Summers] One more new species of *Notocypraea*. The Cowry, 1(5): 65-66.
- [Mit R. Summers] A further note on *Blasicrura coxeni* (Cox). The Cowry, 1(5): 68.
- The overlapping distribution of *Erosaria eburnea* (Barnes). The Cowry, 1(5): 69-70.
- [Mit Maria Schilder] Studies in variation of cowries: The marginal blotches of *Erosaria erosa*. Hawaiian Shell News, 43: 4.

1964 The distribution of *Erronea walkeri* Sowerby (Cypraeidae). Hawaiian Shell News, 49: 7-8.
- A further note on *N. casta*. The Cowry, 1(6): 83-84.
- Do sinistral cowries exist? Hawaiian Shell News, 52: 2.
- *Erosaria ogasawarensis* Schilder 1944. Hawaiian Shell News, 52: 3.
- [Mit Maria Schilder] Chart showing relationship of sex to size among some Hawaiian cowries from one single locality. Hawaiian Shell News, 52: 6.
- Interesting monstrosities in *Cypraea tigris* Linnaeus. Hawaiian Shell News, 53: 5.
- The true habitat of a rare cowry. Hawaiian Shell News, 54: 2.
- The largest cowry species. Hawaiian Shell News, 55: 3.
- Rostrate melanistic cowries from Queensland. Hawaiian Shell News, 56: 3.
- *Primovula striatula tinctura* Garrard. Hawaiian Shell News, 57: 4.
- [Mit Maria Schilder] Minima and maxima in cowry shells. Hawaiian Shell News, 58: 6-8.
- [Mit Maria Schilder] Latitudinal differences in size of East Australian cowries. The Cowry, 1(7): 100.
- Additional remarks to "The Cowry" 1(6). The Cowry, 1(7): 10.
- A newly described cowry species from Melanesia (*Notasdusta rabaulensis*). Hawaiian Shell News, 59: 7.

1965 Artificial subfossils. Hawaiian Shell News, 61: 6.
- A curious cowry shell. Hawaiian Shell News, 63: 3.
- [Mit A. Schelechoff] Another hybrid in cowries? Hawaiian Shell News, 64: 3.
- A new variety of a rare cowry species. Hawaiian Shell News, 66: 4.
- New faunistic relations of Japan to Queensland. Hawaiian Shell News, 66: 5.
- An answer to myself. Hawaiian Shell News, 66: 5.
- A surprising range extension of a cowry species. Hawaiian Shell News, 66: 4.
- [Mit Maria Schilder] Golden Cowry statistics. Hawaiian Shell News, 68: 3-7.
- The meaning of the Latin cowry names. Hawaiian Shell News, 69: 6-7.
- *Cypraea maculifera* from the Seychelles. Hawaiian Shell News, 69: 6.
- [Mit Maria Schilder] Cowries from Tel-Aviv, Israel. Hawaiian Shell News, 71: 7.
- Nomenclaturatural note. Hawaiian Shell News, 71: 7.
- The size of *Erosaria turdus* (Lamarck). The Cowry 1(8): 113.

1966 *Cypraea arenosa* Gray must be replaced by *schilderorum* Iredale. Hawaiian Shell News, 74: 5.
- Cowries from Bowen. Hawaiian Shell News, 74: 7.
- Difficulties in calculating the mean size. Hawaiian Shell News, 75: 6.
- Beaked cowry. Hawaiian Shell News, 76: 7.
- The cowry *Mauritia grayana* Schilder 1930. Hawaiian Shell News, 77: 7.
- *Zoila venusta* and *Zoila episema*. Hawaiian Shell News, 78: 5.
- Statistics on the cowry *Lyncina sulcidentata* (Gray). Hawaiian Shell News, 78: 5.
- [Mit Maria Schilder] Relative frequency of East Australian cowries. Keppel Bay Tidings, 5(1): 3.
- Rediscovery of a unique cowry and three new cowries. Hawaiian Shell News, 79: 6.
- *Zoila friendii* (Gray) in Shark Bay. Hawaiian Shell News, 80: 4.
- [Mit K. Uetz] An eratoid cowry. Hawaiian Shell News, 81: 2.
- Cowries from the Austral Islands. Hawaiian Shell News, 82: 4.
- Notes on some species in Cypraeidae. Hawaiian Shell News, 84: 4.
- An Antillean cowrie discovery in Brazil. Hawaiian Shell News, 84: 4.
- An unexpected discovery. Hawaiian Shell News, 84: 5.
- Cowries from Kenn Reef. Keppel Bay Tidings, 5(3): 3.

1967 Another new species from Australia. Hawaiian Shell News, 86: 4.
- The endemic cowries of South Africa. Conch. Soc. S. Afr. Circ., 82: 3.
- [Mit W. O. Cernohorsky] Re-discovery of *Cribraria fischeri* Vayssière. Hawaiian Shell News, 87: 5.
- *Mauritia mappa* in the Red Sea. Hawaiian Shell News, 88: 5.
- A rare cowry species. Hawaiian Shell News, 88: 5.
- *Erronea pulchella novaebritanniae* Schilder & Schilder. Hawaiian Shell News, 89: 6.
- The second shell of *Erronea barclayi* Reeve. Hawaiian Shell News, 90: 6.
- A large cowrie worth to be hunted for. Keppel Bay Tidings, 5(4): 2.
- [Mit C. Coucom & Maria Schilder] The cowries of One Tree Island. Keppel Bay Tidings, 6(1): 2.
- Two curious cowries. Hawaiian Shell News, 91: 4.
- Dr. Schilder comments of "Fishing for shells". Hawaiian Shell News, 91: 4.
- The regional distribution of cowries. Hawaiian Shell News, 92: 4.
- Correction please. Hawaiian Shell News, 92: 4.
- A new cowry species from Sydney. Hawaiian Shell News, 93: 6.
- Remarks on the validity of two old names. The Cowry, 2(1): 8.
- Invalid specific names of cowries. The Cowry 2(1): 11.
- A curious cowry from Oahu. Hawaiian Shell News, 94: 1.
- An interesting variety. Hawaiian Shell News, 95: 5.
- Whistling up Molluscs. Hawaiian Shell News, 95: 5.
- Calyptraeidae attached to living cowries. Hawaiian Shell News, 96: 5.
- [Mit Maria Schilder] East Australian cowries. Keppel Bay Tidings, 6(3): 4.

1968 A rostrate cowrie from deep water. Hawaiian Shell News, 97: 4.
- An interesting mutation in cowries. Hawaiian Shell News, 98: 5.
- Two closely related cowries. Hawaiian Shell News, 99: 5. (Corrections 101: 7).
- The cowries of East Australia. Keppel Bay Tidings 6(4): 5.
- The second shell of a Sydney cowry. Hawaiian Shell News, 101: 5.
- Further record on *Cypraeovula algoensis* Gray. Conch. Soc. S. Africa Circ. 96: 2.
- A new cowry from Midway Island. Hawaiian Shell News, 100: 5.
- Statistics on a common cowrie. Conch. Soc. S. Africa Circ., 97: 3.
- *Erronea pulchella* in the Red Sea. Hawaiian Shell News, 104: 6.
- Subrecent cowries from Mud Island. Keppel Bay Tidings, 7(1): 2.
- The meaning of Latin cowry names. Keppel Bay Tidings, 7(2): 3. 1969: 7(4): 7, 8(1): 5.
- The cowry *Ovatipsa tortirostris* Sow. Conch. Soc. S. Africa Circ., 102: 3.
- The size of *Erosaria ocellata* (Linn.). Hawaiian Shell News, 107: 3.
- Rostrate melanistic cowries. Keppel Bay Tidings, 7(3): 7.
- Monstrosities in cowries. Hawaiian Shell News, 108: 4.

1969 *Mauritia histrio westralis* Iredale. Hawaiian Shell News, 109: 6.
- Cowries from remote islands. Hawaiian Shell News, 111: 6.
- A curious monstrosity in cowries. Hawaiian Shell News, 112: 4.
- Statistics in *Cypraeovula*. Conch. Soc. S. Africa Circ. , 106: 4.
- Variability in *Erosaria citrina* (Gray). Hawaiian Shell News, 114: 6.
- Sexual differences in cowries. Keppel Bay Tidings 7(4): 5.
- Ancient cowries from Heron Island. Keppel Bay Tidings, 8(1): 3.
- [Mit Maria Schilder] The cowrie *Luponaria alfredensis* is of specific rank. Hawaiian Shell News, 115: 7.
- Another odd *Blasicurura coxeni* (Cox). Hawaiian Shell News, 117: 6.
- A new semi-cowrie from East Africa. Conch. Soc. S. Africa Circ., 113: 1.

- A rare semi-cowrie from East Africa. Conch. Soc. S. Africa Circ., 113: 1.
- Correction please. Hawaiian Shell News, 1(20): 2.

1970 *Phenacovolova labroguttata*, a new South African cowrie. Conch. Soc. S. Africa Circ., 115: 2, 117: 1.
- [Mit Maria Schilder] The number of cowries and semi-cowries. Hawaiian Shell News, 125: 4.
- A subrostrate cowrie from Heron Island. Keppel Bay Tidings, 8(6): 4.
- Further subrecent cowries from Heron Island. Keppel Bay Tidings, 8(6): 6.
- Dorsal markings of *Erosaria helvola*. Hawaiian Shell News, 126: 4.
- *Pseudocypraea admasonii* in East Africa. Hawaiian Shell News, 127: 4.
- Two more *Erronea barclayi* (Reeve) from Natal. Conch. Soc. S. Africa Circ., 121: 1.

Im Druck: The species of the cowrie genus *Cypraeovula* Gray. Conch. Soc. S. Africa Circ.
- A very precious cowrie (*Erronea barclayi*). Hawaiian Shell News.
- Monstrosities in cowries. Hawaiian Shell News.
- A new *Cribrarula?* Hawaiian Shell News.
- Cowries printed on a bill of drinks. Hawaiian Shell News.

MALACOLOGICAL REVIEW, P. O. Box 801, Whitmore Lake, Michigan 48189, U. S. A.

Malacological Review, 1971, 4: 59-66

CONTENTS OF MALACOLOGICAL PERIODICALS, 1969
(Continued from Vol. 3, 1970)

At the time *MALACOLOGICAL REVIEW*, Vol. 3, No. 1 went to press all issues for 1969 of some of the journals had not yet been received at our editorial offices. The contents of these late issues are included here. These journals are *Journal de Conchyliologie*, *Proceedings of the National Shellfisheries Association*, *Comunicaciones de la Sociedad Malacológica del Uruguay*, *Lavori della Società Malacologica Italiana* and *La Conchiglia*.

La Conchiglia is a new monthly publication, being issued first in March 1969. Although it is mainly a magazine for amateur shell collectors, it does contain review materials of scientific merit, so we are including it in our journal coverage.

Volume CVII.—No. 4 Paru le 30 décembre 1969

JOURNAL
DE
CONCHYLIOLOGIE

PAGES

A new genus and species of *Dimyidae* from the caribbean coast of Mexico, by Donald R. MOORE 137
Sur deux formes australiennes de *Dosinia* par E. FISCHER-PIETTE 143
Observations d'écologie littorale concernant une ile de la région de Nha-Trang (Viêt-Nam), par P.-H. FISCHER 144
Nécrologie: J. L. STAADT, par E. FISCHER-PIETTE 147
Correspondance: A propos du "Centre français de Malacologie sur la Côte d' Azur", par Colette MARECHAL 148
Nouvelle: Création de "Malacological Review" 148
Informations: Propositions faites au *Bulletin of Zoological Nomenclature* 148
Bibliographie 149
Table des matières 161
Table alphabétique 166

Le Journal paraît par trimestre

PRIX DE LA SOUSCRIPTION AU VOL. 108 (1970)
PAYABLE D'AVANCE

France ..... 30 francs convertibles Etranger ..... 6 dollars U.S.

Pour toute communication scientifique ou souscription aux volumes en cours, s'adresser à M. P.-H. FISCHER, directeur du Journal, 18/55 Prince Albert Str., Mosman, N.S.W. 2088, Australie.

1969 PROCEEDINGS

NATIONAL SHELLFISHERIES ASSOCIATION

OFFICIAL PUBLICATION OF THE NATIONAL SHELLFISHERIES ASSOCIATION; AN ANNUAL JOURNAL DEVOTED TO SHELLFISHERY BIOLOGY

Volume 60

Published for the National Shellfisheries Association, Inc. by
Economy Printing Co., Inc., Easton, Maryland

June 1970

CONTENTS

List of Abstracts by Author of Technical Papers Presented at the 1969 NSA Convention
Abstracts:
NSA Convention 1
NSA Pacific Coast Section 12
Roland F. Smith
The Role and Responsibility of Estuarine Biologists in the Accelerated Development of Coastal Areas 18
H. J. Squires
Lobster *(Homarus americanus)* Fishery and Ecology in Port au Port Bay, Newfoundland, 1960-65 22
William A Lund, Jr. and Lance L. Stewart
Abundance and Distribution of Larval Lobsters, *Homarus americanus*, off the Coast of Southern New England 40
Evan B. Haynes and John C. McMullen
Relation between Meat Weight and Shell Height of the Giant Pacific Sea Scallop, *Patinopecten caurinus*, from the Gulf of Alaska 50
John J. Manzi
The Effect of Temperature on the Feeding Rate of the Rough Oyster Drill, *Eupleura caudata* (Say) 54
Clyde L. MacKenzie, Jr.
Causes of Oyster Spat Mortality, Conditions of Oyster Setting Beds, and Recommendations for Oyster Bed Management 59
Richard A. Lutz, Herbert Hidu and Klaus G. Drobeck
Acute Temperature Increase as a Stimulus to Setting in the American Oyster, *Crassostrea virginica* (Gmelin) 68
Edwin B. May and Kenneth R. McLain
Advantages of Electronic Positioning and Profiling in Surveying Buried Oyster Shell Deposits 72
F. W. Wheaton
An Engineering Study of the Chesapeake Bay Area Oyster Industry 75
Paul Chanley
Larval Development of the Hooked Mussel, *Brachidontes recurvus* Rafinesque (Bivalvia: Mytilidae) Including a Literature Review of Larval Characteristics of the Mytilidae 86
Wilbur P. Breese and F. Duane Phibbs
Some Observations on the Spawning and Early Development of the Butter Clam, *Saxidomus giganteus* (Deshayes) 95
John W. Ropes and Arthur S. Merrill
Marking Surf Clams 99
Nelson Marshall and Karen Lukas
Preliminary Observations on the Properties of Bottom Sediments with and without Eelgrass, *Zostera marina*, Cover 107
Association Affairs 113

PROCEEDINGS

OF THE

NATIONAL SHELLFISHERIES ASSOCIATION

LIST OF ABSTRACTS BY AUTHOR OF TECHNICAL PAPERS PRESENTED AT THE 1969 NSA CONVENTION

Edwin W. Cake, Jr.
Some Aspects of the Ecology, Biology and Fishery of the Sunray *Venus* Clam 1

Melbourne R. Carriker
An Analysis by Scanning Electron Microscopy of Hole Boring by the Snail *Urosalpinx* 1

Michael Castagna
Field Experiments Testing the Use of Aggregate Covers to Protect Juvenile Clams 2

Joseph M. Cummins, Abner C. Jones and Alan A. Stevens
A *Gymnodinium breve* "Red Tide" Occurrence of Toxic Shellfish 2

Elgin A. Dunnington, Jr., Karla Leum and Dorothy Macgregor
Ability of Buried Oysters to Clear Sediment from the Shell Margin 2

Albert F. Eble
Physiology of the Ripe, Spawning and Spent Surf Clam Gonad 3

Albert F. Eble and Nils Stolpe
The Histochemistry of the Foot Epithelum and Associated Glands of the Surf Clam, *Spisula solidissima* 3

Donald M. Gooch
Studies on Brackish Water Clams of the Genus *Rangia* in Louisiana 3

Harold H. Haskin and Frederick E. Krueger
"MSX" Mortalities in Resistant and Susceptible Oyster Stocks 4

Herbert Hidu, Fletcher P. Veitch, Jr. and Patricia E. O'Brien
Gregarious Setting in the American Oyster 4

William F. Hill, Jr., Elmer W. Akin, Frederick E. Hamblet and William H. Benton
Poliovirus Uptake and Elimination by the American Oyster, *Crassostrea virginica* 5

Robert E. Hillman
An Unusual Occurrence of Internal Calcification in the Mantle of the Quahog 5

Sewell H. Hopkins
Studies on Brackish Water Clams of the Genus *Rangia* in Texas 5

Bob E. Huntley
An Experimental Depuration Plant: Operation and Evaluation 6

Frederick C. Kopfler
A Study of the Elimination of Zinc from Oysters from Upper Mobile Bay 6

John J. Manzi
The Combined Effects of Salinity and Temperature on the Feeding, Reproduction, and Survival Rates of *Eupleura caudata* (Say) and *Urosalpinx cinerea* (Say) (Prosobranchia: Muricidae) 7

Jack Mayer
Determination of Mercury in Oysters by Dithizone 7

R. W. Menzel
The Species and Distribution of Quahog Clams *Mercenaria* 8

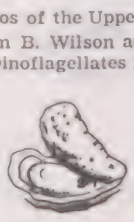
Michael C. Mix and Albert K. Sparks
Cellular Mechanisms Involved in the Repair of Digestive Tissues of the Pacific Oyster Destroyed by Ionizing Radiation 8

John L. Myhre and Harold H. Haskin
"MSX" Infections in Resistant and Susceptible Oyster Stocks 9

Sara V. Otto
Evidence for a Potential Spat Producing Area in Chesapeake Bay 9

H. T. Pfitzenmeyer
Effects of Spoil Disposal on the Benthos of the Upper Chesapeake Bay 9

Sammy M. Ray, David V. Aldrich, William B. Wilson and Anita M. Sievers
Response of Shellfish to Two Toxic Dinoflagellates from the Gulf of Mexico 10



Edwin W. Rhodes, Jr.
Growth of Oyster Larvae, *Crassostrea virginica*, of Various Sizes in Different Concentrations of the Chrysophyte, *Isochrysis galbana* 10
W. H. Roosenburg, K. G. Drobeck, H. Hidu, A. J. McErlean and J. A. Mihursky
Acute Temperature Tolerance of Oyster Larvae as Related to Power Plant Operation 11
William N. Shaw
Raft Production of Seed Oysters in Upper Chesapeake Bay 11
L. F. Whitney and J. W. Zahradnik
Fluidization of Juvenile Oysters: A Progress Report 11
Robert M. Yancey
The Surf Clam Fishery — 1968 11
J. W. Zahradnik and C. A. Johnson
Proposed 50 Bushel Pilot Plant for Oyster Production 12

ABSTRACTS NSA PACIFIC COAST SECTION

Louis Barr
Methods of Estimating the Abundance of Juvenile Spot Shrimp in a Shallow Nursery Area 12
Alan J. Beardsley
Some Behavioral Aspects of Shrimp in Relation to Commercial Trawl Gear 13
W. P. Breese
Practical Problems of Phasing an Oyster Hatchery into Production 13
John S. Chambers
Recent Research on Control of Oyster Drills 13
C. Lynn Goodwin
Some Observation on Laboratory Spawning of the Geoduck, *Panope generosa*, and the Culture of Its Larvae 13
Evan Haynes
Age and Growth of Giant Pacific Sea Scallops in the Gulf of Alaska 14
Charles R. Hitz
Hydraulic Clam Dredge Trials in Coastal Waters of Washington and Oregon 14
T. Joyner and J. Spinelli
Mussels, A Potential Source of Protein Concentrate 14
John F. Karinen
Progress in Tanner Crab Research in the Southeastern Bering Sea 15
Vincent A. Price and Kenneth K. Chew
A Progress Report on Pandalid Shrimp Culture 15
C. S. Sayce and D. F. Tufts
Experimental Treatment of the Japanese Oyster Drill, *Ocenebra japonica*, with Polystream, in Willapa Bay, Washington 15
A. J. Scholz, R. E. Westley and M. A. Tarr
Pacific Oyster Mortalities and Environmental Conditions in Washington State 15
R. E. Westley and C. Lynn Goodwin
Management of the Developing Washington Geoduck Fishery 16
R. E. Westley and A. J. Scholz
Comparative Mortality of Pacific Oyster from Five Source Areas 16
Charles E. Woelke
Some Relationships between Temperature and Pacific Northwest Shellfish Production 17

COMUNICACIONES
DE LA
Sociedad Malacológica
DEL
Uruguay

MONTEVIDEO URUGUAY

Vol. II - Nos 16 - 17 Abril - Octubre de 1969

S U M A R I O

Pág.

FIGUEIRAS, Alfredo y BROGGI, Jorge - Estado actual de nuestros conocimientos sobre los moluscos fósiles del Uruguay (Parte III)..... 333

FIGUEIRAS, Alfredo y SICARDI, Omar E. - Catálogo de los Moluscos Marinos del Uruguay.(III)..... 355

DUARTE, Eliseo - "In memoriam" de Pablo R. San Martín..... 379

OLAZARRI, José - Segunda contribución a la bibliografía malacológica uruguaya..... 381

DUARTE, Eliseo - Notas de Secretaría..... 398

Secretario: ELISEO DUARTE

Casilla de Correo No. 1401 Montevideo - URUGUAY

MONTEVIDEO URUGUAY

LAVORI
della
Società Malacologica Italiana
SOMMARIO
Volume VI

Società Malacologica Italiana . . . . . pag. VI

Elenco dei Soci al 31 Dicembre 1969 . . . . . » VII

Attività della Società Malocologica Italiana . . . . . » X

Lavori di Soci pubblicati nel 1968 . . . . . » XI

Recensioni bibliografiche . . . . . » XV

LAVORI

1. Sacchi C. F. & Girod A.: I molluschi d'acqua dolce di alcune stazioni presso Terracina. Ricerche ecologiche e faunistiche.
2. Giusti F.: Notulae malacologicae - II. Il genere *Oxychilus* nell'Arcipelago Toscano.
3. Giusti F.: Notulae malacologicae - IV. L'isola di Montecristo e lo Scoglio d'Affrica.
4. Giusti F.: Notulae malacologicae - V. Le isole di Gorgona, Capraia e Giglio.
5. Sacchi C. F. & Girod A.: I molluschi d'acqua dolce di alcune stazioni presso Terracina. Nota aggiuntiva.
6. Palla P.: Lamellibranchi pliocenico-quaternari del Pedeappennino modenese nella collezione del Museo Civico di Storia Naturale di Milano I^a Parte.
7. Cantaluppi G. & Corti S.: La fauna della « pietra di Moltrasio » (Como).
8. Giusti F.: Due nuove specie di *Oxychilus* in grotte della Toscana: *Oxychilus (Ortizius) tongiorgii* n. sp. ed *Oxychilus (Ortizius) forcartianus* n. sp. (Notulae malacologicae. VI).
9. Giusti F.: *Oxychilus (Ortizius) alliarius* (Miller) nuovo reperto per l'Italia appenninica. (Notulae malacologicae. VII).
10. Pezzoli E.: Fauna malacologica di alcune sorgenti in provincia di Ancona (Marche).
11. Il Simposio sui « Problemi di ecologia dei Molluschi dulcicoli ». Milano, 11-V-1969.
12. Giusti F.: Nuovi dati sulla posizione sistematica e sulla distribuzione geografica in Italia del genere *Pleuropunctum* (Germain, 1929). Notulae malacologicae III.
13. Girod A.: Ecologia e distribuzione di alcuni molluschi terrestri in Lombardia.

SOCIETÀ MALACOLOGICA ITALIANA

Ricostituita a Milano il 10 Gennaio 1963 - Sede in Milano, Viale Piceno 39

Segretario: Ferdinando Toffoletto

Direttore della Rivista: Fernando Ghisotti

Bibliotecario: Franco Sacchetti

1969

La Conchiglia

Redazione, amministrazione e pubblicità: Roma, Piazza S. Lorenzo in Lucina, 35 - Tel. 640.570 - Condiz. d'abbonamento: per 12 numeri lire 2500, per 6 numeri lire 1350, da versare sul c/c postale n. 1/44900 o a mezzo vaglia all'amministrazione della Rivista. Estero il doppio. Numeri arr. lire 350.
Tip. Tibergraf - Roma - Tel. 580.222

DIRETTORE:
KETY NICOLAY

ANNO I - N. 1 MARZO 1969

Presentazione 3
Le belle conchiglie da collezione 5, 8, 9. 12,
prof. Carlo L. Caravelli
Invito al collezionismo 6
Conchiglie di mare che si trovano in terra 7
prof. Alberto Malatesta
Strombus a Cuba 10
Piero Solaini
La conchiglia nell'arte e arredamento 11
Concorrenti ai collezionisti di conchiglie 13
Raniero Maltini
Filatelia Conchiliologica 14
Franca Luccarini
Varietà e curiosità 14
Valutazione delle conchiglie 15

ANNO I - N. 2 APRILE 1969

Invito al collezionismo 3
Le belle conchiglie da collezione 4, 5, 8, 9, 12, 13
prof. Carlo L. Garavelli e Ketty Nicolay
La ricerca delle conchiglie 6, 7
G. Zanardi
La conchiglia attraverso i secoli 10
La conchiglia nell'arte e nell'arredamento 11
Filatelia Conchigliologica 14
F. Luccarini
Notiziario malacologico europeo 15
Valutazione 15

ANNO I - N. 3 MAGGIO 1969

Conchiglie di mare che si raccolgono in terra 3
prof. A. Malatesta
Le belle conchiglie da collezione 4, 5, 8, 9, 13
prof. Carlo L. Garavelli e Kety Nicolay
Invito al collezionismo 6
La ricerca delle conchiglie 7
Gaddo Zanardi
La conchiglia nell'arte e nell'arredamento 10
Diego Crociani
Meraviglie del mare: le madrepore 11, 12
Eugenio Fresi
Filatelia Conchiliologica 14
F. Luccarini
La mostra « Il cammeo oggi » 14
Valutazione 15

ANNO I - N. 4 GIUGNO 1969

La conchiglia attraverso i secoli (II) 3
Le belle conchiglie da collezione 4, 8, 9, 12
prof. Carlo L. Garavelli
Kety Nicolay
Gian Franco Barsotti
Invito al collezionismo
La ricerca delle conchiglie 5
Gaddo Zanardi
L'argonauta argo 6
prof. Marco Tagliabue
Cassidaria echinophora 7
Guido Donati
« Ostriche » all'Elba 10, 11
Alessandro Olschki
Le meraviglie del mare 13
I nudibranchi
Eugenio Fresi
Notizie per gli studiosi di malacologia e i collezionisti 14
Valutazione 15

La Conchiglia

Rivista mensile delle meraviglie del mare

ANNO I - N. 5-6 LUGLIO-AGOSTO 1969

Il Congresso di biologia marina 3

Le belle conchiglie da collezione 4, 5, 9, 11, 12, 13, 16, 17
Prof. Carlo L. Garavelli
Kety Nicolay
Prof. Dario Franchini

Invito al collezionismo 6

La ricerca delle conchiglie 7, 8
Gaddo Zanardi

Il genere Aphorrais 10
Guido Donati

La canzone del Guarracino 14, 15

Un mondo da scoprire 18
C. Tripodi

Note alla canzone del Guarracino 19

Filatelia conchigliologia 19

Le meraviglie del mare 20
G. F. Barsotti

La conchiglia nell'arte e nell'arredamento 21

Offerte, scambi, ricerche 22

Posta del Direttore 22

Valutazione 23

ANNO I - N. 7 SETTEMBRE 1969

Conchiglie di mare che si raccolgono in terra 3
Prof. A. Malatesta

Le belle conchiglie da collezione 4, 5, 8, 9, 11, 12
G. F. Barsotti
Kety Nicolay
C. Tripodi

Invito al collezionismo 6

La ricerca delle conchiglie 7
Gaddo Zanardi

Conchiglie e coralli vanno a scuola a Torre del Greco 10
D. Crociani

Le meraviglie del mare 13
F. Cinelli

Varietà e curiosità 14

Filatelia Conchiologica 14

Valutazione e indice alfabetico delle conchiglie 15

ANNO I - N. 8 OTTOBRE 1969

Le conchiglie attraverso i secoli 3

Le belle conchiglie da collezione 4, 5, 8, 9, 10, 12
G. Barsotti
C. Tripodi
K. Nicolay

Invito al collezionismo 6

La ricerca delle conchiglie 6, 7
G. Zanardi

Le meraviglie del mare 13
E. Fresi

La conchiglia nell'arte e nell'arredamento 11

Filatelia Conchiliologica 14

Varietà e curiosità 14

Offerte e scambi
Posta del Direttore 14

Anno I N. 9-10 Novembre-Dicembre 1969

Conchiglie di mare che si raccolgono in terra 3
S. Durante

le belle conchiglie da collezione 4, 5, 8, 9, 16, 17, 20, 21
D. Franchini
K. Nicolay
C. Tripodi

Invito al collezionismo 6, 10, 11

La ricerca delle conchiglie 7, 10, 12, 13, 14
C. Tripodi
G. Zanardi

Il museo Internazionale di Nizza 15

Filatelia conchiliogica 15

Libri ricevuti 15

Varietà e curiosità 22

Offerte, scambi, richieste 22

Posta del direttore 22

Malacological Review, 1971, 4: 67-70

AUTHOR INDEX FOR MALACOLOGICAL PERIODICALS, 1969*

	page**
AKIN, Elmer W., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A.	61
ALDRICH, David V., Marine Laboratory, Texas A & M University, Galveston, Texas, U.S.A.	61
BARR, Louis, Bureau of Commercial Fisheries, Biological Laboratory, Auke Bay, Alaska, U.S.A.	62
BARSOTTI, Gianfranco, Istituto di Zoologia dell'Università, Via Mattioli 4, 53100 Siena, Italy	65, 66
BEARDSLEY, Alan J., Fish and Wildlife Service, Bureau of Commercial Fisheries, Seattle, Washington, U.S.A.	62
BENTON, William H., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A.	61
BREESE, Wilbur P., Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon, U.S.A.	60, 62
BROGGI, Jorge, Juan Ramón Gómez 3221, Montevideo, Uruguay	63
CAKE, Edwin W., Jr., Florida State University, Tallahassee, Florida, U.S.A.	61
CANTALUPPI, Giammario, Istituto di Paleontologia dell'Università, Strada Nuova, 27100 Pavia, Italy	64
CARRIKER, Melbourne R., Systematics-Ecology Program, Marine Biological Laboratory, Woods Hole, Massachusetts, U.S.A.	61
CASTAGNA, Michael, Virginia Institute of Marine Science, Wachapreague, Virginia, U.S.A.	61
CHAMBERS, John S., Washington Department of Fisheries, Brinnon, Washington, U.S.A.	62
CHANLEY, Paul, O/SD Sea Farms, Inc., 502 Colony Street, Melbourne Beach, Florida, U.S.A.	60
CHEW, Kenneth K., College of Fisheries, University of Washington, Seattle, Washington, U.S.A.	62
CINELLI, F. [no address given]	66
CORTI, Serafino, Istituto di Paleontologia dell'Università, Strada Nuova, 27100 Pavia, Italy	64
CROCIANI, Diego [no address given]	65, 66
CUMMINS, Joseph M., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A.	61
DONATI, Guido [no address given]	65, 66
DROBECK, Klaus G., Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A.	60, 62
DUARTE, Eliseo, Casilla de Correo No. 1401, Montevideo, Uruguay	63
DUNNINGTON, Elgin A., Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A.	61
DURANTE, S. [no address given]	66
EBLE, Albert F., Department of Biology, Trenton State College, Trenton, New Jersey, U.S.A.	61
FIGUEIRAS, Alfredo, Juan Ramón Gómez 3248, Montevideo, Uruguay	63

*For 1969 periodicals listed in this issue of *Malacological Review*, p 59-66. For other 1969 malacological periodicals, see *Malacological Review*, 3: 37-75 (author index, p 77-88).

**Page numbers this issue of *Malacological Review*.

	page
FISCHER, P.-H., 18/55 Prince Albert St., Mosman, N.S.W. 2088, Australia	59
FISCHER-PIETTE, E., Laboratoire de Malacologie, Muséum National d'Histoire Naturelle, 55, Rue de Buffon, Paris V^{e}, France	59
FRANCHINI, Mario, Via Cremona 37, 46100 Mantova, Italy	66
FRESI, Eugenio [no address given]	65, 66
GARAVELLI, Carlo L., Istituto di Mineralogia dell'Università, Palazzo Ateneo, 70100 Bari, Italy	65, 66
GIROD, Alberto, Via Savona 94/A, I-20144, Milano, Italy	64
GIUSTI, Folco, Istituto di Zoologia dell'Università, Via Mattioli 4, 53100, Siena, Italy	64
GOOCH, Donald M., Department of Biology, University of Southwestern Louisiana, Lafayette, Louisiana, U.S.A.	61
GOODWIN, C. Lynn, Washington Department of Fisheries, Brinnon, Washington, U.S.A.	62
HAMBLET, Frederick E., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A.	61
HASKIN, Harold H., Oyster Research Laboratory, New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey, U.S.A.	61
HAYNES, Evan, Bureau of Commerical Fisheries, Biological Laboratory, Auke Bay, Alaska, U.S.A.	60, 62
HIDU, Herbert, University of Maryland, Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A.	60, 61, 62
HILL, William F., Jr., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A.	61
HILLMAN, Robert E., Wm. F. Clapp Laboratories, Inc. of Battelle Memorial Institute, Duxbury, Massachusetts, U.S.A.	61
HITZ, Charles R., Bureau of Commerical Fisheries, Exploratory Fishing and Gear Research Base, Seattle, Washington, U.S.A.	62
HOPKINS, Sewell H., Department of Biology, Texas A & M University, College Station, Texas, U.S.A.	61
HUNTLEY, Bob E., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A.	61
JOHNSON, C.A., Department of Agricultural Engineering, University of Massachusetts, Amherst, Massachusetts, U.S.A.	62
JONES, Abner C., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A.	61
JOYNER, T., U.S. Dept. Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Seattle, Washington, U.S.A.	62
KARINEN, John F., Bureau of Commercial Fisheries, Biological Laboratory, Auke Bay, Alaska, U.S.A.	62
KOPFLER, Frederick C., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A.	61
KRUEGER, Frederick E., Oyster Research Laboratory, New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey, U.S.A.	61
LEUM, Karla, Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A.	61
LUCCARINI, Franco [no address given]	65
LUKAS, Karen, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island, U.S.A.	60
LUND, William A., Jr., Marine Research Laboratory, University of Connecticut, Noank, Connecticut, U.S.A.	60

page

LUTZ, Richard A., Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A. 60
MACGREGOR, Dorothy, Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A. 61
MacKENZIE, Clyde L., Jr., Bureau of Commercial Fisheries, Biological Laboratory, Milford, Connecticut, U.S.A. 60
MALATESTA, Alberto, Servizio Geologico d'Italia, Largo Santa Susanna 13, Roma, Italy 65, 66
MALTINI, Raniero [no address given] 65
MANZI, John J., Bureau of Commercial Fisheries, Biological Laboratory, Milford, Connecticut, U.S.A. 60, 61
MARECHAL, Colette, 13 Rue Moliere, Nice 06, France 59
MARSHALL, Nelson, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island, U.S.A. 60
MAY, Edwin B., Alabama Marine Resources Laboratory, Dauphin Island, Alabama, U.S.A. 60
MAYER, Jack, Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A. 61
McERLEAN, A.J., Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A. 62
McLAIN, Kenneth R., Radcliff Materials, Inc., Mobile, Alabama, U.S.A. 60
McMULLEN, John C., Alaska Department of Fish and Game, Kodiak, Alaska, U.S.A. 60
MENZEL, R.W., Department of Oceanography, Florida State University, Tallahassee, Florida, U.S.A. 61
MERRILL, A.S., U.S. Fish and Wildlife Service, Biological Laboratory, Bureau of Commercial Fisheries, Oxford, Maryland 21654, U.S.A. 60
MIHURSKY, J.A., Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A. 62
MIX, Michael C., College of Fisheries, University of Washington, Seattle, Washington, U.S.A. 61
MOORE, Donald R., Institute of Marine Sciences, University of Miami, Virginia Key, Miami, Florida 33149, U.S.A. 59
MYHRE, John L., Oyster Research Laboratory, N.J. Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey, U.S.A. 61
NICOLAY, Kety, via Tomacelli, 146-IV P., 00186, Roma, Italy 65, 66
O'BRIEN, Patricia E., Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A. 61
OLAZARRI, José, Cooper 2033, Carrasco, Montevideo, Uruguay 63
OLSCHKI, Alessandro [no address given] 65
OTTO, Sara V., Department of Chesapeake Bay Affairs, Annapolis, Maryland, U.S.A. 61
PALLA, Piero [no address given] 64
PEZZOLI, Enrico, Via Giancarlo Puecher 9, 20127 Milano, Italy 64
PFITZENMEYER, H.T., Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A. 61
PHIBBS, F. Duane, Marine Science Center, Fish Commission of Oregon, Newport, Oregon, U.S.A.
PRICE, Vincent A., College of Fisheries, University of Washington, Seattle, Washington, U.S.A. 62
RAY, Sammy M., Marine Laboratory, Texas A & M University, Galveston, Texas, U.S.A. 61

page

RHODES, Edwin H., Jr, Bureau of Commercial Fisheries, Biological Laboratory, Milford, Connecticut, U.S.A. 62
ROOSENBURG, W.H., Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A. 62
ROPES, John W., Bureau of Commercial Fisheries, Biological Laboratory, Oxford, Maryland 21654, U.S.A. 60
SACCHI, Cesare F., Via Sardegna 53, 20146 Milano, Italy 64
SAYCE, C.S., Willapa Shellfish Laboratory, Washington Department of Fisheries, Ocean Park, Washington, U.S.A. 62
SCHOLZ, A.J., Washington Department of Fisheries, Brinnon, Washington, U.S.A. 62
SHAW, William N., Bureau of Commercial Fisheries, Biological Laboratory, Oxford, Maryland, U.S.A. 62
SICARDI, Omar E., Coquimbo 2371, Montevideo, Uruguay 63
SIEVERS, Anita M., Marine Laboratory, Texas A & M University, Galveston, Texas, U.S.A. 61
SMITH, Roland F., Bureau of Commercial Fisheries, Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C., U.S.A. 60
SOLAINI, Piero [no address given] 65
SPARKS, Albert K., College of Fisheries, University of Washington, Seattle, Washington, U.S.A. 61
SPINELLI, J., U.S. Dept. Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Seattle, Washington, U.S.A. 62
SQUIRES, H.J., Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland, Canada 60
STEVENS, Alan A., Gulf Coast Water Hygiene Laboratory, P.O. Box 158, Dauphin Island, Alabama 36528, U.S.A. 61
STEWART, Lance L., Marine Research Laboratory, University of Connecticut, Noank, Connecticut, U.S.A. 60
STOLPE, Nils, Trenton State College, Trenton, New Jersey, U.S.A. 61
TAGLIABUE, Marco [no address given] 65
TARR, M. A., Washington Department of Fisheries, Brinnon, Washington, U.S.A. 62
TRIPODI, C. [no address given] 66
TUFTS, D.F., Willapa Shellfish Laboratory, Washington Department of Fisheries, Ocean Park, Washington, U.S.A. 62
VEITCH, Fletcher P., Natural Resources Institute, Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A. 61
WESTLEY, R.E., Washington Department of Fisheries, Brinnon, Washington, U.S.A. 62
WHEATON, F.W., Agricultural Engineering Department, University of Maryland, College Park, Maryland, U.S.A. 60
WHITNEY, L.F., Department of Agricultural Engineering, University of Massachusetts, Amherst, Massachusetts, U.S.A. 62
WILSON, William B., Marine Laboratory, Texas A & M Laboratory, Galveston, Texas, U.S.A. 61
WOELKE, Charles E., Washington State Department of Fisheries, Olympia, Washington, U.S.A. 62
YANCEY, Robert M., Bureau of Commercial Fisheries, Biological Laboratory, Oxford, Maryland, U.S.A. 62
ZAHRADNIK, J.W., Department of Agricultural Engineering, University of Massachusetts, Amherst, Massachusetts, U.S.A. 62
ZANARDI, Gaddo [no address given] 65, 66

Malacological Review, 1971, 4: 71-99

CONTENTS OF MALACOLOGICAL PERIODICALS, 1970

The current contents of malacological periodicals for 1970, as shown by their tables of contents, are herewith reproduced (with permission) as a service to our readers. Those journals that do not appear in this current issue of *MALACOLOGICAL REVIEW* will be included in the next number (Vol. 4, No. 2).

Tables of contents of publications included in this issue of *MALACOLOGICAL REVIEW* are:

	country [1]	page
Malacologia	International [2]	72
Journal de Conchyliologie	Australia [3]	75
Archiv für Molluskenkunde	Germany (FRG) [4]	77
The Journal of Conchology	U. K. and Ireland [5]	79
The Nautilus	U. S. A. [6]	80
Proceedings of the Malacological Society of London	U. K. [7]	82
Venus	Japan [8]	83
Basteria	Netherlands [9]	87
Journal of the Malacological Society of Australia	Australia [10]	89
The Veliger	U. S. A. [11]	92

[1] Footnotes 2-11 list the main editorial offices of the various journals.

[2] Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U. S. A.

[3] 18/55 Prince Albert St., Mosman, N. S. W. 2088, Australia.

[4] Senkenbergischen Naturforschenden Gesellschaft, Senckenberg-Anlage 25, 6 Frankfurt 1, W. Germany.

[5] The Nook, Uplands Road, Bromborough, Cheshire, U. K.

[6] Delaware Museum of Natural History, Greenville, Delaware 19807, U. S. A.

[7] Department of Zoology, The University, London Road, Reading RG1 5AQ, U. K.

[8] National Science Museum, Ueno Park, Taito-ku, Tokyo, Japan.

[9] Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

[10] 3 Nantes Street, Newtown, Geelong, Victoria 3220, Australia.

[11] Department of Zoology, University of California, Berkeley, California 94720, U. S. A.

Vol. 9, No. 2 MALACOLOGIA December, 1969

CONTENTS

F. MARINESCU

Velutinellus, nouveau genre fossile de la familie des Lymnaeidae, et ses relations avec *Velutinopsis* et *Valenciennius* 313

C. S. RICHARDS

Genetic studies on *Biomphalaria glabrata*: tentacle and eye variations. 327

C. S. RICHARDS

Genetic studies on *Biomphalaria glabrata*: mantle pigmentation . . . 339

C. N. D'ASARO

The comparative embryogenesis and early organogenesis of *Bursa corrugata* Perry and *Distorsio clathrata* Lamarck (Gastropoda: Prosobranchia). 349

C. J. BAYNE

Survival of the embryos of the grey field slug *Agriolimax reticulatus* following desiccation of the egg 391

J. W. STRUHSAKER and J. D. COSTLOW, JR.

Some environmental effects on the larval development of *Littorina picta* (Mesogastropoda), reared in the laboratory 403

D. K. YOUNG

The functional morphology of the feeding apparatus of some Indo-West-Pacific dorid nudibranchs 421

S. C. BROWN

The structure and function of the digestive system of the mud snail *Nassarius obsoletus* (Say) 447

A. M. S. SALEUDDIN

Isoenzymes of alkaline phosphatase of *Anodonta grandis* Say (Bivalvia: Unionidae) during shell regeneration 501

Published by the Institute of Malacology, c/o The University of Michigan, Ann Arbor, Mich. 48104, U.S.A. and Printed by V. Sethuram at Hoe & Co., the 'Premier' Press, 31, Stringers Street, Madras-1, INDIA

MALACOLOGIA

International Journal of Malacology
Revista Internacional de Malacologia
Journal International de Malacologie
Международный Журнал Малакологии
Internationale Malakologische Zeitschrift

* * * * * *

EDITORIAL OFFICES

Museum of Zoology
University of Michigan
Ann Arbor, Michigan 48104
U.S.A.

C. J. BAYNE, *General Editor*
C. M. PATTERSON, *Managing Editor*
S. -K. WU, *Business Manager*
M. S. GLADSTONE, *Secretary*
J. B. BURCH, *Editor-in-Chief*

19, Road 12
Maadi, Egypt, U.A.R.

A. GISMANN, *General Editor*

Center for Advanced
Study in Marine Biology
Marine Biological Station
Porto Novo, Tamilnadu State
India

R. NATARAJAN, *Associate Editor*

MALACOLOGIA is published by the Institute of Malacology, 1336 Bird Road, Ann Arbor, Michigan, U.S.A. The Sponsor Members of this Institute, also serving as editors, are listed below.

N. F. SOHL, *President*
R. ROBERTSON, *President-Elect*
J. F. ALLEN, *Vice-President*
C. R. STASEK, *Secretary*
K. J. BOSS, *Treasurer*

E. G. BERRY
J. B. BURCH
M. R. CARRIKER
G. M. DAVIS
A. G. SMITH

Subscription price of MALACOLOGIA for North American institutions is US$10.00. Subscription prices for all others and addresses for ordering are listed below:

$A 6.25

MALACOLOGIA
c/o Australian Museum
6-8 College St.
Sydney
Australia

Fr. 35.00

MALACOLOGIA
c/o Muséum National
d'Histoire Naturelle
55, Rue de Buffon
Paris V^e^, France

US$7.00

MALACOLOGIA
Museum of Zoology
University of Michigan
Ann Arbor, Mich. 48104
U.S.A.

Rs 53.00

MALACOLOGIA
c/o Marine Biological Sta.
Porto Novo
Tamilnadu State
India

MALACOLOGIA

Vol. 10, No. 1 May, 1970

CONTENTS

SYMPOSIUM ON RARE AND ENDANGERED MOLLUSKS

D. H. STANSBERY
Eastern Freshwater Mollusks. (I) The Mississippi and St. Lawrence River Systems 9
A. H. CLARKE
Discussion of D. H. Stansbery's paper 21
W. H. HEARD
Eastern Freshwater Mollusks. (II) The South Atlantic and Gulf Drainages. . 23
H. D. ATHEARN
Discussion of W. H. Heard's paper 28
D. W. TAYLOR
Western Freshwater Mollusks. (Summary) 33
H. D. MURRAY
Discussion of D. W. Taylor's paper 33
W. J. CLENCH
Eastern Land Snails 35
D. S. DUNDEE
Discussion of W. J. Clench's paper 36
A. G. SMITH
Western Land Snails 39
R. T. ABBOTT
Eastern Marine Mollusks 47
J. ROSEWATER
Discussion of R. T. Abbott's paper 49
A. M. KEEN
Western Marine Mollusks 51
W. K. EMERSON
Discussion of A. M. Keen's paper 52
J. P. E. MORRISON
Brackish-Water Mollusks 55

REGULAR PAPERS

A. M. CVANCARA
Mussels (Unionidae) of the Red River Valley in North Dakota and Minnesota, U. S. A. 57
H. van der SCHALIE
Hermaphroditism Among North American Freshwater Mussels 93
P. T. CLAMPITT
Comparative Ecology of the Snails *Physa gyrina* and *Physa integra* (Basommatophora: Physidae) 113
N. V. WILLIAMS
Studies on Aquatic Pulmonate Snails in Central Africa
I. Field Distribution in Relation to Water Chemistry 153
N. V. WILLIAMS
Studies on Aquatic Pulmonate Snails in Central Africa
II. Experimental Investigation of Field Distribution Patterns 165
E. MARCUS and E. MARCUS
Some Gastropods from Madagascar and West Mexico 181
L. R. KRAEMER
The Mantle Flap in Three Species of *Lampsilis* (Pelecypoda: Unionidae). . . 225

Volume CVIII.—No. 1 Paru le 31 mars 1970

JOURNAL
DE
CONCHYLIOLOGIE
COMPRENANT
L'ÉTUDE DES MOLLUSQUES
VIVANTS ET FOSSILES

FONDÉ EN 1850 PAR

S. PETIT DE LA SAUSSAYE

CONTINUÉ PAR

Dr P. FISCHER, A.-C. BERNARDI, H. CROSSE
H. FISCHER, MADAME H. FISCHER
Ph. DAUTZENBERG, G. F. DOLLFUS, Ed. LAMY
P.-H. FISCHER & E. FISCHER
P.-H. FISCHER

DIRECTION, RÉDACTION ET ADMINISTRATION:

P.-H. FISCHER

—

1970

Le Journal paraît par trimestre

TABLE DES MATIÈRES

CONTENUES DANS CETTE LIVRAISON

PAGES

The Subgenus *Armata* Folin, of the Genus *Caecum*, by Donald R. MOORE 3

Sur la variété saharienne du *Rumina decollata* Linné. 1758 et sa dispersion géographique et altimétrique, par Francis LLABADOR 6

Sur quelques types de *Calyptraea* conservés dans la Collection de l'Ecole des Mines de Paris, par P.-H. FISCHER 16

Sur la répartition de *Trochatella radians* Lk. (*Calyptraeidae*), par P.-H. FISCHER 19

Correspondance: Annonce par le Dr. J.-J. VAN MOL 27

Bibliographie 28

Le Journal paraît par trimestre

PRIX DE LA SOUSCRIPTION AU VOL. 108 (1970)
PAYABLE D'AVANCE

France ..... 30 francs convertibles Etranger ..... 6 dollars U.S.

Pour toute communication scientifique ou souscription aux volumes en cours, s'adresser à M. P.-H. FISCHER, directeur du Journal, 18/55 Prince Albert Str., Mosman, N.S.W. 2088, Australie.

Archiv für Molluskenkunde

der Senckenbergischen Naturforschenden Gesellschaft
Organ der Deutschen Malakozoologischen Gesellschaft

Begründet von Prof. Dr. W. KOBELT
Weitergeführt von Dr. W. WENZ und Dr. F. HAAS
Herausgegeben von Dr. A. ZILCH

Band 100 Nummer 1/2

Inhalt.

ZILCH, A.: Fritz Haas (1886-1969). 1

HÄSSLEIN, L.: Hans Modell (1898-1969). 19

NORDSIECK, H.: Zur Anatomie und Systematik der Clausilien, VIII. Dinarische Clausiliidae, II: Das Genus *Medora*. (Tafel 1-6). 23

HUDEC, V.: *Alopia (Kimakowiczia) grossui* n. sp. aus dem Bucegi-Gebirge in Rumänien. 77

SZEKERES, M. I.: Zwei neue Clausiliidae aus Südtonkin. 81

SCHLICKUM, W. R.: Neue tertiäre Landschnecken. 83

— — — : Zur Molluskenfauna der Brackwassermolasse Niederbayerns, 3. Was ist *Lymnea bouilleti* MICHAUD? 89

SCHMID, G.: *Arion lusitanicus* in Deutschland. 95

GÖTTING, K.-J.: Zur Gastropoden-Fauna Anatoliens. 103

FORCART, L.: Die Schalenunterschiede zwischen *Catinella (Quickella) arenaria* (BOUCHARD-CHANTEREAUX) und *Succinea (Succinella) oblonga* DRAPARNAUD. 109

Frankfurt am Main 1970

Arch. Moll. | 100 | (1/2) | 1—112 | Frankfurt a. M., 29.5.1970

Archiv für Molluskenkunde

Band 100 Nummer 3/4

Inhalt.

BOETERS, H. D.: Die Gattung *Microna* CLESSIN, 1890 (Prosobranchia, Hydrobiidae). (Tafel 7-9). 113

ZILCH, A.: *Microna* ZIEGLER in FRAUENFELD 1863. 147

SCHÜTT, H. & BILGIN, F. H.: *Pseudamnicola geldiayana* n. sp., a spring-inhabiting snail of the Anatolian Plateau. 151

ZILCH, A.: Zwei weitere *Conus gloriamaris* in deutschen Museen. (Tafel 10). 159

SCHLICKUM, W. R. & STRAUCH, F.: Fossile Arten der Gattungen *Soosia* P. HESSE und *Helicigona* RISSO. (Tafel 11-12). 165

KLAPPENBACH, M. A. & OLAZARRI, J.: Notas sobre Strophocheilidae (Moll. Gastr.), III. *Eoborus*, nuevo género para especies fósiles de esta familia sud-americana. 179

BRANDT, R. A. M.: New freshwater gastropods from the Mekong. (Tafel 13). 183

HECKER, U.: Zur Kenntnis der mitteleuropäischen Bernsteinschnecken (Succineidae). II. 207

PLATE, H.-P.: Siegfried H. Jaeckel (1892—1970). 235

Arch. Moll. | 100 | (3/4) | 113—242 | Frankfurt a. M., 31. 8. 1970

Band 100 Nummer 5/6

Inhalt.

NORDSIECK, H.: Die *Chondrina*-Arten der dinarischen Länder. 243

VARGA, A.: *Daudebardia (Cibinia) crystallina* n. sp. 263

SZEKERES, M. I.: Neue Angaben zur Clausilienfauna von Iran und der Türkei. 267

PIEPER, H.: Die Orculiden der SO-Ägäis. 271

— — —: Zur Kenntnis der *Laciniaria denticulata* (OLIVIER 1801) in der SO-Ägäis. 275

HELLER, J.: Two newly discovered species of the genus *Buliminus* BECK, 1837 (= *Petraeus* ALBERS, 1850) (Enidae) from Southern Israel. 279

LANGER, W.: Über *Penicillus (Pseudobrechites)* MAGNE 1941. 287

SCHLICKUM, W. R.: Zur Gattung *Nystia* TOURNOUËR 291

GIUSTI, F.: Notulae Malacologicae VIII. Una nuova specie appenninica di *Belgrandia* e nueve considerazioni sui rapporti sistematici tra i generi *Belgrandia* e *Sadleriana* (Gastropoda: Prosobranchia). 295

SCHÜTT, H.: Neue Formen höhlenbewohnender Hydrobiiden des Balkan und ihre Beziehungen zu *Paladilhiopsis* PAVLOVIĆ 1913. (Tafel 14-15) 305

ZILCH, A.: Die Typen und Typoide des Natur-Museums Senckenberg, 45: Mollusca, Hydrobiidae (1): *Bythiospeum* BOURGUIGNAT. (Tafel 16-19). 319

KIMAKOWICZ, R. WINNICKI VON: Erwiderung. 347

Frankfurt am Main 1970

Arch. Moll. | 100 | (5/6) | 243—348 | Frankfurt a. M., 15. 12. 1970

The Journal of Conchology

PUBLISHED BY THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

Contents

Vol. 27 No. 2 April, 1970

PAGE

S. P. DANCE—"Le Fanatisme du Nobis": A Study of J.-R. Bourguignat and the "Nouvelle Ecole". 65
S. P. DANCE—List of J.-R. Bourguignat's Publications on Molluscs 87
NORA F. MCMILLAN—*Adula simpsoni* (Marshall) in Shetland 96
M. P. KERNEY and B. S. MORTON—The Distribution of *Dreissena polymorpha* (Pallas) in Britain 97
R. E. BAKER—Population Changes Shown by *Cochlicopa lubrica* (Müller) in a Grass Sward Habitat 101
EDWIN KELLOCK—*Agriolimax agrestis* (L.) in the Moray Firth Area of Scotland 105
Book Review 110
DENNIS PALLANT—A note on the Faeces of *Agriolimax reticulatus* (Müller) 111
Review 114
M. P. KERNEY—*Pisidium tenuilineatum* Stelfox in Sussex 115
D. C. LONG—*Abida secale* (Draparnaud) in the North Cotswolds 117
BERNARD VERDCOURT—A Reassessment of Species Described from East Africa by W. Blume 121
Advert 126
SHELAGH M. SMITH—*Ensis* from the Firth of Forth 127
D. H. KENNELLY—Obituary. Percy Elston (?—1969) 130
L. W. STRATTON—Conchology and Archaeology, Mollusca at Verulamum... 131

Contents

Vol. 27 No. 3 October, 1970

PAGE

J. HOLEMAN and A. J. KOHN—The Identity of *Conus mappa* (Lightfoot), *C. insularis* Gmelin, *C. aurantius* Hwass in Bruguière and Hwass's Infraspecific Taxa of *C. cedonulli* 135
Book Review 138
THE EARL OF CRANBROOK—Snail Shells under Starling Roosts 139
Book Review 144
M. P. KERNEY—The British Distributions of *Monacha cantiana* (Montagu) and *Monacha cartusiana* (Müller) 145
S. P. DANCE—Non-marine Molluscs of Borneo: Streptaxidoe 149
D. M. DUVAL—Some Aspects of the Behaviour of Pest Species of Slugs ... 163
L. W. STRATTON—Numbers of Shells 171
S. P. DANCE—*Pisidium lilljeborgi* Clessin, in the River Teifi, West Wales 177
ALAN SOLEM—Obituary Fritz Haas 182
L. PINTÉR—Recent Zonitidae in Hungary 183
Unitas Malacologica Europaea 190
R. STOREY—The Importance of Mineral Particles in the Diet of *Limnaea peregeri* (Müller) 191
Book Review 196
NORA F. MCMILLAN—Some Irish Naturalists, mostly Conchological 197
Reviews 204

Price in the U.S.A. $5.50 **Price £2**

THE NAUTILUS

Vol. 83 JANUARY, 1970 No. 3

CONTENTS

Mode of life of *Conocardium*, a Paleozoic pelecypod. By David Nicol 77

The distribution of the nudibranch, *Doris verrucosa* Linné, in the northwest Atlantic. By David R. Franz 80

Cymatium boschi, a new species from the Arabian Sea. By R. T. Abbott and Hal Lewis 86

Aspella myrakeenae, new species from Western Mexico. By W. K. Emerson and A. D'Attilio 88

New Mitridae and Volutomitridae. By Walter O. Cernohorsky 95

Rediscovery of the limpet, *Acroloxus coloradensis*, in Colorado. By George W. Bryce, Jr. 105

Longevity in *Ashmunella*, *Monadenia* and *Sonorella*. By Munroe L. Walton 109

Notes and news ..... 112 Publications received ... iii

Vol. 83 APRIL, 1970 No. 4

CONTENTS

Fritz Haas, 1886-1969. By Alan Solem 117

Shell variability in *Polygyra dorfeuilliana*. By Branley A. Branson 120

Latirus varai, a new fasciolariid gastropod from the Caribbean. By Robert C. Bullock 133

Maintenance of land mollusks in the laboratory. By W. Patrick Carney 136

Histological studies of the nephridium and pericardial lining of *Quadrula nodulata*. By P. R. Myers and D. S. Franzen 139

Another record of insect dispersal of an Ancylid snail. By Joseph Rosewater 144

Notes ..... 145 News 146

Mrs. Horace B. Baker, Business Manager
11 Chelten Road, Havertown, Pennsylvania 19083

THE NAUTILUS

THE PILSBRY QUARTERLY
DEVOTED TO THE INTERESTS OF CONCHOLOGISTS

Vol. 84 JULY, 1970 No. 1

CONTENTS

The occurence of Cymatiidae and Cypraeidae in North Carolina. By Hugh J. Porter 1

Eggs and attachment sites for egg capsules of *Valvata lewisi*. By B. Z. Lang and N. O. Dronen, Jr. 9

One more sinistral *Mesodon*. By Harold S. Feinberg 12

Defensive liquid discharge in Florida tree snails (*Liguus fasciatus*). By T. Eisner and E. O. Wilson 14

Growth of *Amblema perplicata* Conrad in a Texas river. By J. W. Little and Harry W. Gentner 16

Alterations in the molluscan fauna of a meromictic marl lake. By Willard N. Harman 21

A forgotten periodical of West American conchology. By Barry Roth and James T. Carlton 31

Notes ..... 32 Publications received iii

Vol. 84 OCTOBER, 1970 No. 2

CONTENTS

The Leo George Hertlein Honor Issue

Biographical sketch of Leo G. Hertlein. By Warren O. Addicott 37

Taxa proposed in honor of Leo G. Hertlein from 1926 to 1969. By Barry Roth 42

Bibliography of Leo G. Hertlein for the period of 1925–1970. By Warren O. Addicott 43

Names proposed by Leo G. Hertlein from 1925 to 1970. By Barry Roth 52

New Pliocene *Chlamys* (*Swiftopecten*) and *Beringius* from the Alaska Peninsula. By F. S. MacNeil 69

Pelecypods, successful invaders of the infauna. By David Nicol 75

News iii

$4.25 per year ($4.75 to Foreign Countries) $1.25 a copy.

PROCEEDINGS OF THE

Malacological Society

OF LONDON

VOLUME 39 · PART 1 · APRIL 1970

CONTENTS

CAROL M. LALLI. Morphology of *Crucibranchaea macrochira* (Meisenheimer), a gymnosomatous pteropod 1

MALCOLM EDMUNDS. Opisthobranchiate Mollusca from Tanzania. II. Eolidacea (Cuthonidae, Piseinotecidae and Facelinidae) 15

PAUL CHANLEY and MATOIRA CHANLEY. Larval development of the commensal clam, *Montacuta percompressa* Dall 59

R. W. MCQUISTON. Fine structure of the gastric shield in the lamelibranch bivalve, *Lasaea rubru* (Montagu) 69

HENRI TERMIER and GENEVIÈVE TERMIER. On a new Cretaceous isognomonid of Afghanistan and the significance of the bakevelliid hinge 77

D. PALLANT. A quantitative study of feeding in woodland by the grey field slug (*Agriolimax reticulatus* (Müller)) 83

Review 89

Notice 91

BLACKWELL SCIENTIFIC PUBLICATIONS
OXFORD AND EDINBURGH

Printed in Great Britain by Willmer Brothers Limited, Birkenhead

VENUS

THE JAPANESE JOURNAL OF MALACOLOGY

VENUS Vol. 28, No. 4 (1970)

目　　次 CONTENTS

原　　著 Original Articles

スヘプマン記載（シボハ・コレクション）のクダマキガイ科の再検討
（第1部）（図版X－XI）……首藤次男…161

Taxonomical Notes on the Turrids of the Siboga-Collection Originally Described by M. M. SCHEPMAN, 1913 (Part 1) (Plates X–XI)
……Tsugio SHUTO

ヒナコダマウサギ属について（ウミウサギ科）（挿図1－7）……東　正　雄…179

New Genus *Habuprionovalva* (Ovulidae) (Text-figs. 1－2)……Masao AZUMA

南シナ海から採集されたカセンガイ類の新亜属と新種の記載
（挿図1－3）……波部忠重・小菅貞男…182

Description of New Subgenus and Species of *Latiaxis* from the South China Sea (Text-figs. 1－3)……Tadashige HABE and Sadao KOSUGE

資　　料 Short Note

ラオス産淡水貝 *Pachydrobia pellucida* の触角および眼の奇型について
（図版XII）……羅　進　宗…186

Some Abnormal Tentacles and Eyes of *Pachydrobia pellucida* BAVAY, 1895 (Gastropoda: Hydrobiidae) (Plate XII) ……Chin-Tsong LO

抄録と紹介　Review and Abstract

東正雄氏の陸貝2論文（波部忠重）……185
ハース著：イシガイ超科（波部忠重）……189
ダンス著：珍らしい貝（波部忠重）……190
日本産カワニナ類の分類に関する2論文（波部忠重）……191
「ネオピリナ」は現在8種（奥谷喬司）……192

学会記事 Proceedings

東京支部例会……194
近畿地区会……194
阪神貝類談話会……194
会　　告……裏表紙

VENUS
THE JAPANESE JOURNAL OF MALACOLOGY

VENUS Vol. 29, No. 1 (1970)

目　　次 CONTENTS

原　　著 Original Articles

南支那海から採集されたヒタチオビの一新種（挿図 1–2）……波部　忠重・小菅　貞男…… 1
Description of New Species of *Fulgoraria* from the South China Sea (Text-figs. 1–2) ……Tadashige HABE and Sadao KOSUGE
南支那海から得られたヒタチオビ科の一新型の記載および最近記録された一種 *F. fumerosa* Rehder について（図版 1）……鹿間　時夫・小菅　貞男…… 5
Description of a New Form of *Fulgoraria* from the South China Sea with a Note on *F. fumerosa* Rehder, 1967 (Plate 1) ……Tokio SHIKAMA and Sadao KOSUGE
ウスペニギセルの産卵と発育過程……小菅　貞男・小菅　文代…… 9
Spawning and Growth Rate of a Clausiliid Snail, *Tyrannophaedusa* (*Ventriphaedusa*) *aurantiaca*……Sadao KOSUGE and Fumiyo KOSUGE
びわ湖産イボカワニナ類3種の研究（I）殻形態及び生息場所の比較（挿図 1–15；表 1–2）……渡辺　直……13
Studies on Three Species of *Semisulcospira* in Lake Biwa I) Comparative Studies of Shell Form and Habitat (Text-figs. 1–15; Tables 1–2) ……Naoshi C. WATANABE

雑　　録 Miscellany

河本卓介氏を悼む（小菅貞男）……31

抄録と紹介 Review and Abstract

国際動物命名規約委員会決定事項（波部忠重）……
ノーチラス誌（82～3）（大山　桂）……11
有殻翼足類（大山　桂）……12

学会記事 Proceedings

新入会員名簿……32
会員異動……33
雑誌投稿についての変更……34

VENUS

Published by
THE MALACOLOGICAL SOCIETY OF JAPAN

VENUS: Vol. 29, No. 2 (1970)

目　　次 CONTENTS

原　　著 Original Articles

タカラガイの1新種の記載（図版 2）……ヒリップ・クローバー… 35
Description of a New Cowry from Taiwan (Plate 2) ……Phillip W. CLOVER

スヘプマン記載（シボハ・コレクション）のクダマキガイ科の再検討（第2部）（図版 3～4）……首藤次男… 37
Taxonomical Note on the Turrids of the Siboga-Collection Originally Described by M. M. SCHEPMAN, 1913 (Part 2) (Plates 3～4) …… Tsugio SHUTO

日本産ケシカニモリガイ科の2新種（挿図 1～3）……波部忠重… 55
Two New Cerithiopsid Species from Japan (Text-figs. 1～3) …… Tadashige HABE

クチマガリマイマイ亜属の1新種（挿図 1～3）……東　正雄… 59
Description of a New Species of Subgenus *Coelorus* PILSBRY, 1906 from Ôita Pref., Japan (Text-figs. 1～3) ……Masao AZUMA

資　　料 Short Note

渦虫類の1種，イイジマヒラムシによる広島産養殖カキの被害（挿図 1～9）……荒川好満… 65
Notes on Damage to Cultured Oysters in Hiroshima Caused by Predation of a Species of Turbellarian, *Stylochus ijimai* YERI et KABURAKI (Text-figs. 1～9) ……Kohman Y. ARAKAWA

抄録と紹介 Review and Abstract

パウエル著印度太平洋産クダマキガイ科 2：タイワンイグチガイ亜科（波部忠重）……54, 58, 64

ジェレツキー著（1966）化石鞘形類の比較形態・系統と分類（滝　　厳）…… 72

学 会 記 事 Proceedings

昭和45(1970)年度総会報告 …… 74

VENUS
THE JAPANESE JOURNAL OF MALACOLOGY

VENUS: Vol. 29, No. 3 (1970)

目　　次 CONTENTS

原　　著 Original Articles

和歌山県名田沖産イモガイ科の1新種（挿図 1～6）……東　正雄・土岐願三郎…77
Description of a New Cone Shell from Kii Peninsula, Honshu (Text-figs. 1～6)……Masao AZUMA and Raisaburo TOKI
フィリピンおよび台湾産イモガイ類2新種の記載（図版 5）……波部忠重・小菅貞男…81
Descriptions of Two New Species of Cone Shell from the Philippines and Taiwan (Plate 5)……Tadashige HABE and Sadao KOSUGE
新属新種クロハラカセンガイ（挿図 1～2）……波部忠重…85
Tarantellaxis kuroharai n. gen et sp. (Rapidae, Gastropoda) from Japan (Text-figs. 1～2)……Tadashige HABE
ミッドウェー島近海産腹足類の3新種（図版 6）……波部忠重・小菅貞男…87
Descriptions of Three New Gastropoda from the Sea around Midway Island (Plate 6)……Tadashige HABE and Sadao KOSUGE
びわ湖産イボカワニナ類3種の研究（II）歯舌形態の比較（挿図 1～5）……渡辺　直…93
Studies on Three Species of *Semisulcospira* in Lake Biwa (II) Comparative Studies of Radulae (Text-figs. 1～5)……Naoshi C. WATANABE

資　　料 Short Note

アダムズの記載したトウガタガイ類の学名の変更……ジェームス　コルガン…99
Nomenclatural Note on Asiatic Pyramidellid Gastropods of Arthur ADAMS……James X. CORGAN

雑　　録 Miscellany

[illegible]……101

抄録と紹介 Review and Abstract

真珠の百科（滝　巌）…… 80
真珠（滝　巌）…… 80
パシフィック　シェル　ニュース（滝　巌）…… 80
[illegible]…… 84
アコヤガイの活力判定法に関する研究（滝　巌）…… 84
イトグルマガイ科の再検討（波部忠重）…… 92

BASTERIA

TIJDSCHRIFT VAN DE
NEDERLANDSE MALACOLOGISCHE
VERENIGING

*

REDACTIE
Dr. W.S.S. van der Feen-van Benthem Jutting
Dr. A.C. van Bruggen

REDACTIE-ADRES
Rijksmuseum van Natuurlijke Historie
Leiden, Nederland

*

Vol. 34, No. 1–2, pp. 1–42
31 - III - 1970

INHOUD

J.G.J. KUIPER & W.J. WOLFF: The Mollusca of the estuarine region of the rivers Rhine, Meuse and Scheldt in relation to the hydrography of the area. III. The genus Pisidium .
C.O. VAN REGTEREN ALTENA: Boekbespreking (Nordsieck, Prosobranchia) 41

LEIDEN

BASTERIA

Vol. 34, No. 3–4, pp. 43–90
15 - VIII - 1970

INHOUD

E. GITTENBERGER: Trachycardium porulosum (Solander) aangespoeld in Zeeland 43
B. VERDCOURT: Notes on Kenya land and freshwater snails 10. Variation in the Gulella ugandensis complex (Streptaxidae) 45
F.E. LOOSJES & C. ALTIMIRA ALEU: Notes concernant Laminifera (Bofilliella) subarcuata (Bofill) 55
BOOK REVIEW: Haas, Unionacea, Das Tierreich 58
H.K. MIENIS: Notes on recent and fossil Neritidae 1. Notes on Nerita olivaria and Nerita junghuhni 61
C.O. VAN REGTEREN ALTENA: Notes sur les limaces 17. Sur deux espèces de Deroceras 67
W.J. WOLFF: The Mollusca of the estuarine region of the rivers Rhine, Meuse and Scheldt in relation to the hydrography of the area IV. The genus Sphaerium .. 75

Vol. 34, No. 5–6, pp. 91–154
15 - XII - 1970

INHOUD

L.A. BUCK, P. CAMPBELL & G. CLAUS: Radiotracer studies on the nutrition of the early larvae of Ostrea edulis 91
S. VAN DER SPOEL: Morphometric data on Cavoliniidae, with notes on a new form of Cuvierina columnella (Rang, 1827) (Gastropoda, Pteropoda) 103
H.E. COOMANS: Boekbespreking (Dance) 152
A.C. VAN BRUGGEN Boekbespreking (Nordsieck, Bivalvia) 152
Inhoud van Vol. 34 154

REDACTIE-ADRES
Rijksmuseum van Natuurlijke Historie
Leiden, Nederland

VOLUME 2 NUMBER 1 AUGUST 1970

JOURNAL OF THE MALACOLOGICAL SOCIETY OF AUSTRALIA

Published annually by
The Malacological Society of Australia

THE MALACOLOGICAL SOCIETY OF AUSTRALIA

The aim of the Society is to promote the study of recent and fossil Mollusca and associated invertebrates.

Membership of the Society is open to all persons. Members receive the *Journal* and the quarterly *Australian Newsletter* and may attend meetings of the Society wherever held by branches in Australia and New Guinea. Junior members, under 18 years, have the same privileges as Members except the right to vote at meetings and hold office. Second members of a family (husband or wife) can become Members of the Society for a reduced fee and have the same privileges except receipt of the *Journal* and *Australian Newsletter*. Corporate membership is available to institutions, societies, etc.

All enquiries regarding the Society and membership should be addressed to: Honorary Secretary, Malacological Society of Australia, C o. The Australian Museum, P.O. Box A285, South Sydney, N.S.W., 2000.

Membership rates:

Members	$4.50
Junior Members	1.50
Second Member of a Family	1.50
Corporate Members	4.50

Members and Corporate Members pay an entrance fee of $2.00, Junior Members and second Member of a family $1.00.

THE JOURNAL OF THE MALACOLOGICAL SOCIETY OF AUSTRALIA

The *Journal* is an annual publication for authoratative scientific papers dealing with Mollusca and related topics.

Volume 2 (1) is the 1970 issue and the list of contents will be found in this brochure. A limited number of complete sets of Volume 1 (1-12), published between 1957 and 1969, is still available, together with separate numbers. The subscription rate for Volume 2 is $4.50 Aust. per number to individuals and $3.00 Aust. to institutional libraries. The complete set of Volume 1 is priced at $22.00 Aust. and the separate numbers at $2.00 Aust.

Subscription enquiries for the Journal should be addressed to: The Journal Treasurer, Malacological Society of Australia, C/o. Dr. B. J. Smith, National Museum of Victoria, Russell Street, Melbourne, Victoria, 3000.

Editorial enquiries regarding the Journal should be addressed to: Mr. Robert Burn, Editor, Journal M.S.A., 3 Nantes Street, Newtown, Geelong, Victoria, 3220. Instructions to authors for the Journal are available upon request.

JOURNAL OF THE MALACOLOGICAL SOCIETY OF AUSTRALIA

VOLUME 2 NUMBER 1 AUGUST 1970

CONTENTS

W. F. PONDER. A new archibenthal species of Fasciolariidæ from New Zealand ....

W. B. RUDMAN. *Chelidonura inornata* Baba and C. *electra* sp. nov. from the Solomon Islands ....

B. J. SMITH. Notes on the anatomy of *Victaphanta atramentaria* (Shuttleworth) and *V. compacta* (Cox and Hedley), and the designation of a neotype for *V. atramentaria* ....

W. B. RUDMAN. A revision of the genus *Philine* in New Zealand with descriptions of two new species ....

W. BERGMANS. The validity of the genera *Lissarca, Austrosarepta, Cratis* and *Denticosa*, with notes on some Australian species ....

A. G. BEU. Taxonomic position of *Lippistes pehuensis* Marwick, with a review of the species of *Concholepas* ....

W. F. PONDER. A new aplacophoran from New Zealand ....

W. F. PONDER. Some aspects of the morphology of four species of the neogastrapod family Marginellidæ with a discussion on the evolution of the toxoglossan poison gland ....

R. BURN. Taxonomic notes on *Eolis militaris* Alder and Hancock, 1864 ....

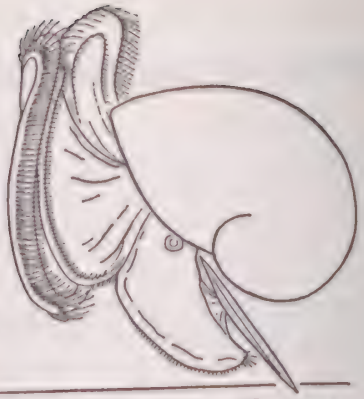
A. G. BEU. A living species of *Austrotriton* from New South Wales

T. HABE. A new subspecies of *Fissidentalium formosum* (Adams and Reeve) from the South China Sea ....

Copyright © Council of the Malacological Society of Australia 1970

Printed in Australia by
Mercer Print, Geelong, Victoria.

THE VELIGER



A Quarterly published by
CALIFORNIA MALACOZOOLOGICAL SOCIETY, INC.
Berkeley, California

VOLUME 12 January 1, 1970 NUMBER 3

CONTENTS

The Endodontoid Land Snail Genera *Pilsbrycharopa* and *Paryphantopsis* (Mollusca : Pulmonata). (3 Text figures)
ALAN SOLEM 239

Reproductive Cycle of the Coot Clam, *Mulinia lateralis* (SAY), in Long Island Sound. (Plates 37, 38; 1 Text figure)
ANTHONY CALABRESE 265

Three New Species of Muricacean Gastropods from the Eastern Pacific. (Plates 39 and 40; 4 Text figures)
WILLIAM K. EMERSON & ANTHONY D'ATTILIO 270

A New Species of *Helminthoglypta* from the Mojave Desert. (Plate 41; 2 Text figures)
WALTER B. MILLER 275

Two New Species of the Genus *Caldukia* BURN & MILLER, 1969 (Mollusca : Gastropoda : Opisthobranchia) from New Zealand Waters. (21 Text figures)
MICHAEL C. MILLER 279

Occurrence of a Rare Squid, *Chaunoteuthis mollis* APPELLÖF (Family Onychoteuthidae) in the Indian Ocean. (Plate 42; 1 Text figure)
K. N. NESIS 290

A Note on the Chromosome Number and Interrelationships in the Marine Gastropod Genus *Thais* of the United States Pacific Coast. (Plate 43)
MUZAMMIL AHMED & ALBERT K. SPARKS 293

Five New Species of *Terebra* from the Eastern Pacific. (Plate 44)
TWILA BRATCHER & R. D. BURCH 295

Observations on the Anatomy and Biology of Two California Vermetid Gastropods. (Plate 45; 4 Text figures)
MICHAEL G. HADFIELD 301

New Species of Panamic Marine Gastropods. (Plate 46)
JAMES H. MCLEAN 310

[Continued on Inside Front Cover]

Distributed free to Members of the California Malacozoological Society, Inc.
Subscriptions (by Volume only) payable in advance to Calif. Malacozool. Soc., Inc.
Volume 13: $18.- Domestic; $19.- in the Americas; $19.50 in all other Foreign Countries
Single copies this issue $14.-. Postage extra.

Send subscription orders to MRS. JEAN M. CATE, 12719 San Vicente Boulevard, Los Angeles, California 90049. *Address all other correspondence to* Dr. R. STOHLER, *Editor*, Department of Zoology, University of California, Berkeley, California 94720

Second Class Postage paid at Berkeley, California

THE VELIGER

CONTENTS — *Continued*

Correlation of Radula Tooth Structure and Food Habits of Three Vermivorous Species of *Conus*. (Plate 47)
JAMES NYBAKKEN 316
Observations on the Reproductive Biology of the Kellet's Whelk, *Kelletia kelletii* (Gastropoda : Neptuneidae). (Plates 48 and 49; 4 Text figures)
RICHARD J. ROSENTHAL 319
The West American Species of *Murexiella* (Gastropoda : Muricidae), Including Two New Species. (Plate 50)
EMILY H. VOKES 325
Two New Epitoniidae from the Galápagos Islands (Mollusca : Gastropoda). (Plate 51)
HELEN DUSHANE 330
An Ecological Study of Valley-Forest Gastropods in a Mixed Mesophytic Situation of Northern Kentucky. (7 Text figures; 3 Tables)
BRANLEY A. BRANSON & DONALD L. BATCH 333
A New Species of *Muricopsis* from West Mexico. (Plate 52; 4 Text figures)
GEORGE E. RADWIN & ANTHONY D'ATTILIO 351
Two New Species of Deepwater Bivalves from the Caribbean Sea. (Plate 53; 2 Text figures)
HAROLD E. VOKES 357
Descriptions of a New Genus and Eight New Species of Eastern Pacific Fissurellidae, with Notes on Other Species. (Plate 54; 1 Text figure)
JAMES H. MCLEAN 362
On CERNOHORSKY's Designation of a Lectotype for *Murex mancinella* LINNAEUS.
HAROLD E. VOKES 368
A List of Recommended Nomenclatural Changes for MACFARLAND's "Studies of Opisthobranchiate Mollusks of the Pacific Coast of North America.
RICHARD A. ROLLER 371

NOTES & NEWS 375
Range Extensions for *Acanthodoris hudsoni* MACFARLAND, 1905, and *Onchidoris bilamellata* (LINNAEUS, 1767). GARY R. MCDONALD
Spawning Notes V. – *Acanthina angelica* I. OLDROYD, 1918 and *Acanthina lugubris* (SOWERBY, 1821). (6 Text figures) FAY HENRY WOLFSON

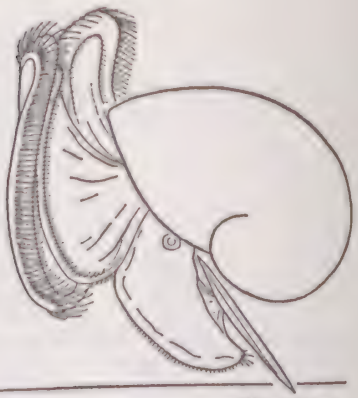
METHODS & TECHNIQUES 379
A Mechanical Shell Washer. (2 Text figures) JACQUELIN N. MILLER & CARL L. HUBBS

BOOKS, PERIODICALS & PAMPHLETS 381

Note: The various taxa above species are indicated by the use of different type styles as shown by the following examples, and by increasing indentation.

ORDER, Suborder, DIVISION, Subdivision, SECTION,
SUPERFAMILY, FAMILY, Subfamily, *Genus, (Subgenus)*
New Taxa

THE VELIGER



A Quarterly published by
CALIFORNIA MALACOZOOLOGICAL SOCIETY, INC.
Berkeley, California

VOLUME 12 April 1, 1970 NUMBER 4

CONTENTS

A Report on the Feeding of *Dendronotus iris* on the Anthozoan *Cerianthus* sp. from Monterey Bay, California (Plates 55 to 57)
DON R. WOBBER 383

Cargoa cupella, New Genus and New Species of Nudibranch from Chesapeake Bay and the Generic Status of *Okenia* MENKE, *Idalia* LEUCKART, and *Idalla* ØRSTED (5 Text figures)
ROSALIE M. VOGEL & LEONARD P. SCHULTZ 388

Malacological Applications of Scanning Electron Microscopy. I. Introduction and Shell Surface Features (Plates 58 to 60)
ALAN SOLEM 394

The Effect of Wave Impact on some Aspects of the Biology of Sea Mussels (9 Text figures)
J. R. E. HARGER 401

Supplementary Comments on Deep Water Volutidae from the South China Sea and South Africa (Plate 61)
HARALD A. REHDER 415

Uptake of Sea Water into the Fluid Spaces of the Prosobranch Gastropod, *Acmaea scutum*
H. H. WEBBER 417

Notes on the Deep Water Calliostomas of the Panamic Province, with Descriptions of Six New Species (Plate 62)
JAMES H. MCLEAN 421

An Annotated Bibliography of References to Marine Mollusca from the Northern State of Sonora, Mexico
CAROL SKOGLUND 427

[Continued on Inside Front Cover]

Distributed free to Members of the California Malacozoological Society, Inc.
Subscriptions (by Volume only) payable in advance to Calif. Malacozool. Soc., Inc.
Volume 13: $18.- Domestic; $19.- in the Americas; $19.50 in all other Foreign Countries
Single copies this issue $14.-. Postage extra.
Send subscription orders to Mrs. JEAN M. CATE, 12719 San Vicente Boulevard, Los Angeles, California 90049. *Address all other correspondence to* Dr. R. STOHLER, *Editor*, Department of Zoology, University of California, Berkeley, California 94720

Second Class Postage paid at Berkeley, California

THE VELIGER

CONTENTS — *Continued*

The Systematics and Some Aspects of the Ecology of the Genus *Dendronotus* (Gastropoda : Nudibranchia) (Plates 63 and 64; 28 Text figures)
GORDON A. ROBILLIARD 433

Notes on the Egg Capsules and Larval Development of *Conus purpurascens* BRODERIP (10 Text figures)
JAMES NYBAKKEN 480

A Supplement to the Annotated List of Opisthobranchs from San Luis Obispo County, California
RICHARD A. ROLLER 482

NOTES & NEWS 484

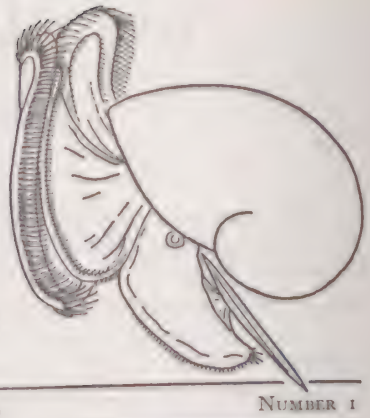
Concerning the Validity of the New Species of *Paravitrea* Proposed by BRANSON & BATCH, 1970. LANDON T. ROSS & LAWRENCE G. ABELE

BOOKS, PERIODICALS & PAMPHLETS 487

Note: The various taxa above species are indicated by the use of different type styles as shown by the following examples, and by increasing indentation.

ORDER, Suborder, DIVISION, Subdivision, SECTION,
SUPERFAMILY, FAMILY, Subfamily, *Genus, (Subgenus)*
New Taxa

THE VELIGER



A Quarterly published by
CALIFORNIA MALACOZOOLOGICAL SOCIETY, INC.
Berkeley, California

VOLUME 13 July 1, 1970 NUMBER 1

CONTENTS

The Anatomy and Functional Morphology of the Reproductive System in the Opisthobranch Mollusk *Phyllaplysia taylori* DALL, 1900 (5 Plates; 13 Text figures)
ROBERT D. BEEMAN 1

An Aberrant *Cryptomphalus (Helix) aspersa* (MÜLLER) from Southern California (1 Plate)
T. W. FISHER 32

Occurrence of the Spirochaete Genus *Cristispira* in Western Canadian Marine Bivalves
F. R. BERNARD 33

Egg Capsules of Some Prosobranchs from the Pacific Coast of Panama (6 Text figures)
CHARLES N. D'ASARO 37

Comparisons among Growth Characteristics of Two Species of Sea Mussel, *Mytilus edulis* and *Mytilus californianus* (11 Text figures)
J. R. E. HARGER 44

Calotrophon, a New World Muricid Genus (Gastropoda : Muricacea) (1 Plate; 6 Text figures)
JAMES H. MCLEAN & WILLIAM K. EMERSON 57

Two New Species of Janolidae from Toyama Bay, Japan (Gastropoda: Nudibranchia) (3 Text figures)
KIKUTARÔ BABA & TAKEO ABE 63

Some Associates of *Tresus nuttallii* (CONRAD, 1837) (Pelecypoda : Mactridae) from Humboldt Bay, California
WILLIAM E. STOUT 67

[Continued on Inside Front Cover]

Distributed free to Members of the California Malacozoological Society, Inc.
Subscriptions (by Volume only) payable in advance to Calif. Malacozool. Soc., Inc.
Volume 13: $18.- Domestic; $19.- in the Americas; $19.50 in all other Foreign Countries
Single copies this issue $14.-. Postage extra.
Send subscription orders to Mrs. JEAN M. CATE, 12719 San Vicente Boulevard, Los Angeles, California 90049. *Address all other correspondence to* Dr. R. STOHLER, *Editor*, Department of Zoology, University of California, Berkeley, California 94720

Second Class Postage Paid at Berkeley, California

THE VELIGER

CONTENTS — *Continued*

New Eastern Pacific Subgenera of *Turbo* LINNAEUS, 1758, and *Astraea* RÖDING, 1798
JAMES H. McLEAN 71

Swimming Gastropods (Opisthobranchia and Prosobranchia) (20 Text figures)
WESLEY M. FARMER 73

Commensal Activity as a Function of Age in Two Species of California Abalones (Mollusca : Gastropoda) (2 Plates; 2 Text figures)
JOHN C. HANSEN 90

An Ecological Study of Two Sympatric Species of *Fasciolaria* (Mollusca: Gastropoda) in Alligator Harbor, Florida (1 Plate; 9 Text figures)
FRED ETHAN WELLS, Jr. 95

The Date of Publication of GOULD's "Descriptions of Shells from the Gulf of California"
EUGENE V. COAN 109

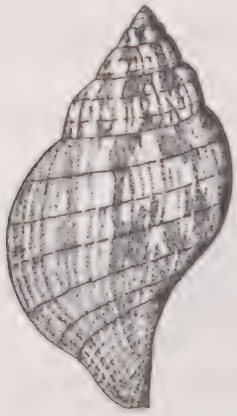
NOTES & NEWS 110

Additional Remarks on Studies of Cenozoic Marine Mollusks of the Pacific Coast WARREN O. ADDICOTT

Dolabrifera dolabrifera (RANG, 1828): Range Extension to the Eastern Pacific (1 Text figure) HANS BERTSCH

On the Authorship of Part V of ESCHSCHOLTZ's "Zoologischer Atlas," 1833 JAMES H. McLEAN

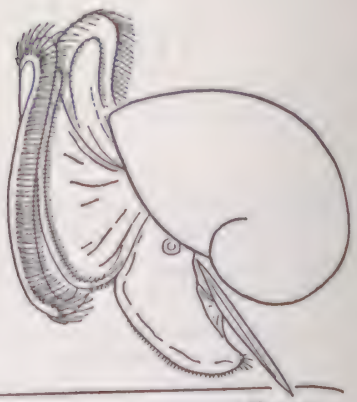
BOOKS, PERIODICALS & PAMPHLETS 114



Note: The various taxa above species are indicated by the use of different type styles as shown by the following examples, and by increasing indentation.

ORDER, Suborder, DIVISION, Subdivision, SECTION,
SUPERFAMILY, FAMILY, Subfamily, *Genus, (Subgenus)*
New Taxa

THE VELIGER



A Quarterly published by
CALIFORNIA MALACOZOOLOGICAL SOCIETY, INC.
Berkeley, California

VOLUME 13 October 1, 1970 NUMBER 2

CONTENTS

Reproductive Biology and Shell Site Preferences in *Hipponix conicus* (SCHUMACHER) (Gastropoda : Hipponicidae) (1 Plate; 5 Text figures)
HELENE M. LAWS 115

The pH Tolerance of Embryos and Larvae of the Coot Clam, *Mulinia lateralis* (SAY) (2 Text figures)
ANTHONY CALABRESE 122

The Relationship between the Number of Varices and Total Shell Length in Some New Zealand Cymatiidae (Gastropoda : Prosobranchia) and its Ecological Significance (1 Plate; 6 Text figures)
J. H. LAXTON 127

The *Nerita ascensionis* Species Complex (Gastropoda: Prosobranchia) in the South Atlantic (1 Plate)
GEERAT J. VERMEIJ 135

Morphometry of Two Species of the Squid Family Ommastrephidae. (3 Text figures; 2 Tables)
JOHN H. WORMUTH 139

Modiolus demissus: A New Host for the Oyster Crab, *Pinnotheres ostreum*, in Virginia
PAUL A. SANDIFER & WILLARD A. VAN ENGEL 145

The Effect of Species Composition on the Survival of Mixed Populations of the Sea Mussels *Mytilus californianus* and *Mytilus edulis* (5 Text figures)
J. R. E. HARGER 147

On *Pecten (Amusium) condoni* HERTLEIN from the West Coast of North America. (1 Plate)
KÔICHIRÔ MASUDA & WARREN O. ADDICOTT 153

[Continued on Inside Front Cover]

Distributed free to Members of the California Malacozoological Society, Inc.
Subscriptions (by Volume only) payable in advance to Calif. Malacozool. Soc., Inc.
Volume 13: $18.- Domestic; $19.- in the Americas; $19.50 in all other Foreign Countries
Single copies this issue $14.-. Postage extra.
Send subscription orders to MRS. JEAN M. CATE, 12719 San Vicente Boulevard, Los Angeles, California 90049. *Address all other correspondence to* Dr. R. STOHLER, *Editor*, Department of Zoology, University of California, Berkeley, California 94720
Second Class Postage Paid at Berkeley, California

THE VELIGER

CONTENTS — *Continued*

The Survival of the Daughter Sporocysts of *Microphallus pygmaeus* (LEVINSEN, 1881) (Trematoda : Microphallidae) in a Chemically Defined Medium (3 Text figures)
DAVID PASCOE, ROY J. RICHARDS & BRIAN L. JAMES 157

Responses of *Gemma gemma* (Mollusca : Pelecypoda) to Catastrophic Burial (6 Text figures)
ERIC SHULENBERGER 163

Observations on Opisthobranchs of the Gulf of California
HANS BERTSCH & ALBERIC A. SMITH 171

The Opisthobranch Mollusks of Marin County, California
TERRENCE M. GOSLINER & GARY C. WILLIAMS 175

A New Species of Japanese Ovulidae (Gastropoda). (1 Text figure)
CRAWFORD N. CATE 181

Some Comments on CERNOHORSKY's "Muricinae of Fiji" (The Veliger, 1967)
EMILY H. VOKES 182

New Gastropod Taxa from Tropical Western America. (1 Plate)
DONALD R. SHASKY 188

METHODS & TECHNIQUES 196

A Compact Aquarium Unit for Macrophotography. (1 Plate; 2 Text figures) J. SHERMAN BLEAKNEY

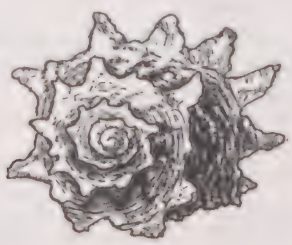
NOTES & NEWS 199

Soviet Contributions to Malacology KENNETH J. BOSS & MORRIS K. JACOBSON

Comment on a Nomenclatural Matter in Mitridae. A. MYRA KEEN

Note on *Micrarionta harperi* (BRYANT, 1900). ALLYN G. SMITH

BOOKS, PERIODICALS & PAMPHLETS 205



Note: The various taxa above species are indicated by the use of different type styles as shown by the following examples, and by increasing indentation.

ORDER, Suborder, DIVISION, Subdivision, SECTION,
SUPERFAMILY, FAMILY, Subfamily, *Genus, (Subgenus)*
New Taxa

Malacological Review, 1971, 4: 100-106

AUTHOR INDEX FOR MALACOLOGICAL PERIODICALS, 1970

	page*
ABBOTT, R. Tucker, du Pont Chair of Malacology, Delaware Museum of Natural History, Greenville, Delaware 19807, U.S.A.	74, 80
ABE, Takeo, Takaoka Senior High School, Takaoka, Toyama-ken, Japan	96
ABELE, Lawrence G., Department of Biological Science, Florida State University, Tallahassee, Florida 32306, U.S.A.	95
ADDICOTT, Warren O., U.S. Geological Survey, Menlo Park, California 94025, U.S.A.	81, 97, 98
AHMED, Muzammil, Department of Zoology, University of Karachi, Karachi, Pakistan	92
ALEU, C. Altimira [no address given]	88
ALTENA, C.O. Van Regteren, Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands	87, 88
ARAKAWA, Kohman Y., Hiroshima Fisheries Experiment Station, Tomokura, Ondo, Aki-gun, Hiroshima, Japan	85
ATHEARN, H., Route 5, Box 375, Cleveland, Tennessee 37311, U.S.A.	74
AZUMA, Masao, 11 Kamiyoshihara, Nishiomiya, Hyogo Pref., Japan	83, 85, 86
BABA, Kikutarô, Osaka Kyoiku University, Tennoji, Osaka, Japan	96
BAKER, R.E., Kenswick College of Education, Norwich, Norfolk, England	79
BATCH, Donald L., Eastern Kentucky University, Richmond, Kentucky 40475, U.S.A.	93
BAYNE, Christopher J., Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U.S.A.	72
BEEMAN, Robert D., Marine Biology Department, San Francisco State College, San Francisco, California 94132, U.S.A.	96
BERGMANS, W., Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands	91
BERNARD, F.R., Fisheries Research Board of Canada, Biological Station, Nanaimo, British Columbia, Canada	96
BERTSCH, Hans, Franciscan School of Theology, 1712 Euclid Avenue, Berkeley, California 94709, U.S.A.	97, 99
BEU, A.G., New Zealand Geological Survey, Lower Hutt, New Zealand	91
BILGIN, Fikret Hakki [no address given]	78
BLEAKNEY, J. Sherman, Department of Biology, Acadia University, Wolfville, Nova Scotia, Canada	99
BOETERS, H.D., Rumfordstr. 42, D-8 Munich 5, West Germany	78
BOSS, Kenneth J., Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts 02138, U.S.A.	99
BRANDT, Rolf A.M., School of Tropical Medicine, Rajvithi Road, Bangkok, Thailand	78
BRANSON, Branley A., Eastern Kentucky University, Richmond, Kentucky 40475, U.S.A.	80, 93
BRATCHER, Twila, 8121 Mullholland Terrace, Hollywood, California 90046, U.S.A.	92
BROWN, Stephen C., Department of Biological Sciences, State University of New York, Albany, New York 12203, U.S.A.	72
BRUGGEN, A.C. van, Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands	88
BRYCE, George W., Jr., Department of Biology, University of Colorado Boulder, Colorado, U.S.A.	80

*Page numbers, this issue of *Malacological Review.*

	page
BUCK, Lawrence A., Graduate Department of Marine Science, Long Island University, Brookville, New York, U.S.A.	88
BULLOCK, Robert C., Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts 02138, U.S.A.	80
BURCH, R.D., P.O. Box 133, Downey, California 90241, U.S.A.	92
BURN, Robert, National Museum of Victoria, Melbourne, Victoria, Australia	91
CALABRESE, Anthony, Bureau of Commercial Fisheries, Biological Laboratory, Milford, Connecticut 06460, U.S.A.	92, 98
CAMPBELL, Phillip, Graduate Department of Marine Science, Long Island University, Brookville, New York, U.S.A.	88
CARLTON, James T., California Academy of Sciences, San Francisco, California 94118, U.S.A.	81
CARNEY, W. Patrick, Department of Zoology, University of Montana, Missoula, Montana 59801, U.S.A.	80
CATE, Crawford N., 12719 San Vicente Boulevard, Los Angeles, California 90049, U.S.A.	99
CERNOHORSKY, Walter O., Auckland Institute and Museum, Auckland, New Zealand	80
CHANLEY, Matoira, 502 Colony Street, Melbourne Beach, Florida 32951 U.S.A.	82
CHANLEY, Paul, 502 Colony Street, Melbourne Beach, Florida 32951, U.S.A.	82
CLAMPITT, Philip T., Cranbrook Institute of Science, Bloomfield Hills, Michigan, U.S.A.	74
CLARKE, A.H. Jr., National Museum of Canada, Ottawa, Ontario, Canada	74
CLAUS, George, The Vanderborgh-Redel Oyster Laboratories, Oyster Bay, New York, U.S.A.	88
CLENCH, W.J., Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.	74
CLOVER, Phillip W., Box 33, Div. 32, FPO, New York, New York 09540, U.S.A.	85
COAN, Eugene V., Department of Geology, California Academy of Sciences Golden Gate Park, San Francisco, California 94118, U.S.A.	97
COOMANS, H.E., Zoologisch Museum, Plantage Middenlaan 53, Amsterdam, Netherlands	88
CORGAN, James X., Austin Peay State University, Clarksville, Tennessee, U.S.A.	86
COSTLOW, John D., Jr., Duke University Marine Laboratory, Beaufort, North Carolina, U.S.A.	72
CRANBROOK, The Earl of, Red House Farm, Great Glemham, Suffolk, England	79
CVANCARA, Alan M., Department of Geology, University of North Dakota Grand Forks, North Dakota 58201, U.S.A.	74
DANCE, S.P., Zoology Department, National Museum of Wales, Cardiff, U.K.	79
D'ASARO, Charles N., Department of Biology and Marine Sciences, The University of West Florida, Pensacola, Florida 32504, U.S.A.	72, 96
D'ATTILIO, A., San Diego Natural History Museum, San Diego, California 92001, U.S.A.	80, 92, 93
DRONEN, Norman O., Jr., Department of Biology, Eastern Washington State College, Cheney, Washington 99004, U.S.A.	81

page

DUNDEE, D.S., Department of Biology, Louisiana State University, New Orleans, Louisiana 70122, U.S.A. 74
DUSHANE, Helen, 15012 El Soneto Drive, Whittier, California 90605, U.S.A. 93
DUVAL, D.M., 49, Humberstone Road, Cambridge, England 79
EDMUNDS, Malcolm, Department of Zoology, University of Ghana, Legon, Ghana 82
EISNER, T., Cornell University, Ithaca, New York 14850, U.S.A. 81
EMERSON, W.K., Department of Living Invertebrates, American Museum of Natural History, 79th St. and Central Park West, New York, New York 10024, U.S.A. 74, 80, 92, 98
FARMER, Wesley M., Department of Zoology, Arizona State University, Tempe, Arizona 85281, U.S.A. 97
FEINBERG, Harold S., American Museum of Natural History, New York, New York 10024, U.S.A. 81
FISCHER, P.-H., 18/55 Prince Albert St., Mosman, N.S.W., Australia 2088 76
FISHER, T.W., Department of Entomology, Division of Biological Control, University of California, Riverside, California 92502, U.S.A. 96
FORCART, Lothar, Zürcherstrasse 9, CH-4000, Basel, Switzerland 77
FRANZ, David R., Systematic and Environmental Biology, Biological Sciences, University of Connecticut, Storrs, Connecticut 06268, U.S.A. 80
FRANZEN, Dorothea A., Department of Biology, Illinois Wesleyan University, Bloomington, Illinois 61701, U.S.A. 80
GENTNER, Harry W., Department of Zoology, University of Oklahoma, Norman, Oklahoma, U.S.A. 81
GITTENBERGER, E., Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands 88
GIUSTI, Foko, Istituto di Zoologie dell'Università di Siena, via Mattioli 4, Siena, Italy 78
GOSLINER, Terrence M., 859 Butterfield Road, San Anselmo, California 94960, U.S.A. 99
GÖTTING, Klaus-Jürgen, I. Zoologisches Institut, Ludwigstrasse 23, 63 Giessen, Germany 77
HABE, Tadashige, Department of Zoology, National Science Museum, Ueno Park, Tokyo, Japan 83, 84, 85, 86, 91
HADFIELD, Michael G., Pacific Biomedical Research Center, University of Hawaii, Honolulu, Hawaii 96822, U.S.A. 92
HANSEN, John C., Moss Landing Marine Laboratories, Moss Landing, California 95039, U.S.A. 97
HARGER, J.R.E., Department of Zoology, University of British Columbia, Vancouver 8, British Columbia, Canada 94, 96, 98
HARMAN, Willard N., Biology Department, New York State University College, Oneonta, New York 13820, U.S.A. 81
HÄSSLEIN, Ludwig, Bertleinstrasse 3, 856 Lauf, Germany 77
HEARD, W.H., Department of Biological Sciences, Florida State University, Tallahassee, Florida 32306, U.S.A. 74
HECKER, Ulrich, Institut für Spezielle Botanik und Pharmakognosie, Saarstrasse 21, 65 Mainz, Germany 78
HELLER, Joseph, Department of Zoology, The Hebrew University, Jerusalem, Israel 78
HOLEMAN, John, 314 Terrace Rd., Schenectady, New York 12306, U.S.A. 79

	page
HUBBS, Carl L., Scripps Institution of Oceanography, University of California, San Diego, California, U.S.A.	93
HUDEC, Vladimír, Donatellova Nr. 2002 (3. Et.), Praha 10-Strašnice, Czechoslovakia	77
JACOBSON, Morris K., American Museum of Natural History, New York, New York 10024, U.S.A.	99
JAMES, Brian J., Department of Zoology, University College, Swansea, Glamorgan, Great Britain	99
KEEN, A. Myra, Department of Geology, Stanford University, Stanford, California 94305, U.S.A.	74, 99
KELLOCK, Edwin, Duntuilm, Knock, Huntly, Aberdeenshire, U.K.	79
KENNELLY, D.H., 65, Park Rise, Harpenden, U.K.	79
KERNEY, M. P., Department of Geology, Imperial College, London S.W.7, England	79
KIMAKOWICZ, Richard Winnicki Von, Str. Sindicatele Unite 5, Sibiu Rumania	78
KLAPPENBACH, Miguel A., Museo Nacional Historia Natural, Casilla de Correo 399, Montevideo, Uruguay	78
KOHN, A.J., Department of Zoology, University of Washington, Seattle Washington, U.S.A.	79 79
KOSUGE, Fumiyo, Department of Zoology, National Science Museum, Ueno Park, Tokyo, Japan	84
KOSUGE, Sadao, Department of Zoology, National Science Museum, Ueno Park, Tokyo, Japan	83, 84, 86
KRAEMER, L.R., Department of Zoology, University of Arkansas, Fayetteville, Arkansas 72702, U.S.A.	74
KUIPER, J.G.J., Institut Neerlandais, 121 Rue de Lille, Paris 7e France	87
LALLI, Carol M., Marine Sciences Centre and Department of Zoology, McGill University, Montreal, Quebec, Canada	82
LANG, Bruce Z., Department of Biology, Eastern Washington State College, Cheney, Washington 99004, U.S.A.	81
LANGER, Wolfhart [no address given]	78
LAWS, Helene M., South Australian Museum, Adelaide, South Australia 5000, Australia	98
LAXTON, J.H., Department of Zoology, University of Queensland Brisbane, Queensland 4067, Australia	98
LEWIS, Hal, 125 McClenaghan Mill Rd., Wynnewood, Pennsylvania 19096, U.S.A.	80
LITTLE, John W., Department of Biology, Prairie View A & M College, Prairie View, Texas 77445, U.S.A.	81
LLABADOR, Francis, Mas "Les Deux-Frères", Chemin des Mendrous, 34 Castelnau-le Lez, France	76
LO, Chin-Tsong, Institute of Pathobiology, Haile Sellassie I University, Addis Ababa, Ethiopia	83
LONG, D.C., 68, Abbeygate Street, Oakleigh, Victoria 3166, Australia	79
LOOSJES, F.E. [no address given]	88
MacNEIL, F. Stearns, 5958 Prather Drive, Fort Myers, Florida 33901, U.S.A.	81
MARCUS, Ernst [deceased]	74
MARCUS, Eveline du Bois-Reymond, Caixa Postal 6994, São Paulo, Brazil	74
MARINESCU, Florian, Institute Géologique du Comité Géologique, Bucarest, Romania	72

	page
MASUDA, Kôichirô, Miyagi University, Sendai, Japan	98
McDONALD, Gary R., 310 Graves Street, San Luis Obispo, California 93401, U.S.A.	93
McLEAN, James H., Los Angeles County Museum of Natural History, 900 Exposition Boulevard, Los Angeles, California 90007, U.S.A.	92, 93, 94, 96, 97
McMILLAN, Nora F., The Nook, Uplands Road, Bromborough, Ches., England	79
McQUISTON, R.W., Department of Anatomy, University College, Cathays Park, Cardiff CF1 3NR, U.K.	82
MIENIS, H.K., Netser Sereni, Doar Beer Jaakov, Israel	88
MILLER, Jacquelin N., Department of Oceanography, University of Hawaii, Honolulu, Hawaii, U.S.A.	93
MILLER, Michael C., Department of Zoology, University of Auckland, Private Bag, Auckland, New Zealand	92
MILLER, Walter B., Department of Biological Sciences, University of Arizona, Tucson, Arizona 85721, U.S.A.	92
MOL, J.-J. van, c/o Section des Invertébrés non Insectes, Musée Royal de l'Afrique Centrale, Tervuren, Belgium	76
MOORE, Donald R., Institute of Marine Sciences, University of Miami Virginia Key, Miami, Florida 33149, U.S.A.	76
MORRISON, J.P.E., Division of Mollusks, U.S. National Museum, Smithsonian Institution, Washington, D.C. 20560, U.S.A.	74
MORTON, B.S., Department of Zoology, Chelsea College of Science and Technology, London S.W.3, England	79
MURRAY, H.D., Trinity University, San Antonio, Texas	74
MYERS, Paul Robert, Department of Biology, Illinois Wesleyan University Bloomington, Illinois 61701, U.S.A.	80
NESIS, K.N., Institute of Oceanology, U.S.S.R. Academy of Sciences, Moscow, U.S.S.R.	92
NICOL, David, Department of Geology, University of Florida, Gainesville, Florida 32601, U.S.A.	80, 81
NORDSIECK, Hartmut, Pfaustrasse 10, 722 Schwenningen a. N., Germany	77, 78
NYBAKKEN, James, Moss Landing Marine Laboratories, Box 223, Moss Landing, California 95039, U.S.A.	93, 95
OLAZARRI, José, Museo Nacional Historia Natural, Casilla de Correo 399, Montevideo, Uruguay	78
PALLANT, Dennis, Brune Park School, Gosport, Hants., U.K.	79, 82
PASCOE, David, Department of Zoology, University College, Swansea, Glamorgan, Great Britain	99
PIEPER, Harold [no address given]	78
PINTÉR, L., Pasaréti út 137, Budapest II, Hungary	79
PLATE, Hans-Peter, Schlüterstrasse 34 II, 1 Berlin 12, Germany	78
PONDER, W.F., The Australian Museum, 6-8 College Street, Sydney, N.S.W. 2000, Australia	91
PORTER, Hugh J., Institute of Marine Sciences, University of North Carolina, Morehead City, North Carolina 28557, U.S.A.	81
RADWIN, George E., San Diego Natural History Museum, San Diego, California 92112, U.S.A.	93
REHDER, Harald A., Division of Mollusks, Smithsonian Institution, Washington, D.C. 20560, U.S.A.	94
RICHARDS, Charles S., Laboratory of Parasitic Diseases, National Institutes of Health, Bethesda, Maryland 20014, U.S.A.	72

page

RICHARDS, Roy J., Department of Zoology, University College, Swansea, Glamorgan, Great Britain 99
ROBILLIARD, Gordon A., Department of Zoology, University of Washington, Seattle, Washington 98105, U.S.A. 95
ROLLER, Richard A., 1127 Seaward Street, San Luis Obispo, California 93401, U.S.A. 93, 95
ROSENTHAL, Richard J., Westinghouse Ocean Research Laboratory, San Diego, California 92121, U.S.A. 93
ROSEWATER, J., Division of Mollusks, U.S. National Museum, Washington, D.C. 20560, U.S.A. 74, 80
ROSS, Landon T., Department of Biological Science, Florida State University, Tallahassee, Florida 32306, U.S.A. 95
ROTH, Barry, California Academy of Sciences, San Francisco, California 94118, U.S.A. 81
RUDMAN, W.B., Department of Zoology, University of Auckland, Auckland, New Zealand 91
SALEUDDIN, A.M.S., Department of Biology, York University, Toronto, Ontario, Canada 72
SANDIFER, Paul A., Virginia Institute of Marine Science, Gloucester Point, Virginia 23062, U.S.A. 98
SCHLICKUM, W. Richard, Hansaring 32, 5 Köln, Germany 77, 78
SCHMID, Günter, Landesstelle für Naturschutz und Landschaftspflege, Favoriteschloss, 714 Ludwigsburg, Germany 77
SCHULTZ, Leonard P., Chesapeake Biological Laboratory, University of Maryland, Solomons, Maryland 20688, U.S.A. 94
SCHÜTT, Hartwig, 4 Düsseldorf-Benrath, Haydnstrasse 50, Germany 78
SHASKY, Donald R., 734 West Highland Avenue, Redlands, California 92373, U.S.A. 99
SHIKAMA, Tokio, Yokohama National University, Yokohama, Japan 84
SHULENBERGER, Eric, Department of General Biology, University of Kansas, Lawrence, Kansas 66044, U.S.A. 99
SHUTO, Tsugio, Department of Geology, Kyushu University, Kyushu, Japan 83, 85
SKOGLUND, Carol, Department of Zoology, Arizona State University, Tempe, Arizona 85281, U.S.A. 94
SMITH, Alberic A., St. Elizabeth's High School, 1530 34th Avenue, Oakland, California 94601, U.S.A. 99
SMITH, Allyn G., Department of Invertebrate Zoology, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118, U.S.A. 74, 99
SMITH, Brian J., National Museum of Victoria, Melbourne, Victoria, Australia 91
SMITH, Shelagh M., 3, Meadowfield Gardens, Edinburgh 8, U.K. 79
SOLEM, Alan, Department of Zoology, Field Museum of Natural History, Chicago, Illinois 60605, U.S.A. 79, 80, 92, 94
SPARKS, Albert K., College of Fisheries, University of Washington, Seattle, Washington 98105, U.S.A. 92
SPOEL, S. van der, Zoölogisch Museum, Plantage Middenlaan 53, Amsterdam, Netherlands 88
STANSBERY, D.H., Ohio State Museum, Columbus, Ohio 43210, U.S.A. 74
STOREY, R., Wolfreton School, East Yorkshire, England 79
STOUT, William E., Marine Science Center, Oregon State University Newport, Oregon 97365, U.S.A. 96

page

STRATTON, L.W., 65, Park Rise, Harpenden, Herts., England 79
STRAUCH, Friedrich, Geologisches Inst. d. Universität, Zülpicherstrasse 47, 5 Köln, Germany 78
STRUHSAKER, Jeanette W., Hawaii Institute of Marine Biology, University of Hawaii, Box 1067, Kaneohe, Hawaii, U.S.A. 72
SZEKERES, Miklós I. [no address given] 77, 78
TAYLOR, Dwight W., Arizona State University, Tempe, Arizona 85281 U.S.A. 74
TERMIER, Geneviève, Laboratoire de Géologie Générale à la Sorbonne, Paris, France 82
TERMIER, Henri, Laboratoire de Géologie Générale à la Sorbonne, Paris France 82
TOKI, Raisaburo [no address given] 86
Van der SCHALIE, H., Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U.S.A. 74
VAN ENGEL, Willard A., Virginia Institute of Marine Science, Gloucester Point, Virginia 23062, U.S.A. 98
VARGA, András, Mátra Múzeum, Gyöngyös, Hungary 78
VERDCOURT, Bernard, Spring Cottage, Kimbers Lane, Maidenhead, Berks., U.K. 79, 88
VERMEIJ, Geerat J. [no address given] 98
VOGEL, Rosalie M., Chesapeake Biological Laboratory, University of Maryland, Solomons, Maryland 20688, U.S.A. 94
VOKES, H.E., Department of Geology, Tulane University, New Orleans, Louisiana 70118, U.S.A. 93
VOKES, Emily H., Tulane University, New Orleans, Louisiana 70118, U.S.A. 93, 99
WALTON, Munroe L., 1108 North Central Ave., Glendale, California 91202, U.S.A. 80
WATANABE, Naoshi C., Otsu Hydrobiological Station, Kyoto University, Otsu, Japan 84, 86
WEBBER, H.H., Department of Biology, Wake Forest University, Winston-Salem, North Carolina 27109, U.S.A. 94
WELLS, Fred Ethan, Jr., Department of Biological Science, The Florida State University, Tallahassee, Florida 32306, U.S.A. 97
WILLIAMS, Gary C., 267 Oak Manor Drive, Fairfax, California 94930, U.S.A. 99
WILLIAMS, N.V., Department of Biology, University of Salford, Salford, Lancs, England 74
WILSON, E.O., Harvard University, Cambridge, Massachusetts, U.S.A. 81
WOBBER, Don R., San Francisco State College, San Francisco, California U.S.A. 94
WOLFF, W.J., Delta Institute for Hydrobiological Research, Yerseke, Netherlands 87, 88
WOLFSON, Fay Henry, San Diego Natural History Museum, San Diego, California 92112, U.S.A. 93
WORMUTH, John H. [no address given] 98
YOUNG, David K., Department of Zoology, University of South Florida, Tampa, Florida, U.S.A. 72
ZILCH, A., Forschungs-Institut, Senckenberg, Frankfurt am Main, W. Germany 77, 78

Malacological Review, 1971,4: 107-119

PUBLICATIONS

Books

ABBOTT, R. Tucker. 1970. *How to know the American marine shells*. Revised ed. 222 p, 12 pls. New American Library, New York, N.Y. US$ 1.25.

FLORES, Celestino. 1969. *Elementos de biologia acuatica*. Manual para educacion media. 320 p. Instituto Oceanografico, Universidad de Oriento, Cumana, Venezuela.

HERVEY, Canon G. A. K. & BARNES, J. A. G. (Eds.) 1970. *Natural history of the Lake District*. Frederick Warne & Co., London. 230 p, 32 pls. £3.

JOHNSTONE, Kathleen Yerger. 1970. *Collecting seashells*. Grosset & Dunlap, Inc., New York, N.Y. 198 p, 6 color pls. US$ 5.95.

KENNELLY, D. H. 1969. *Marine shells of southern Africa*. (2nd ed.) Thomas Nelson & Sons, Cape Town. 123 + vi p, 50 pls.

LA ROCQUE, Aurèle. 1970. *Pleistocene Mollusca of Ohio*. Div. geol. Surv., Dept. natur. Res., State of Ohio, Bull. 62(4): 555 - 800 + i - xxiv, pls. 15-18.

PENNIKET, J. R. & MOON, G. J. H. 1970. *New Zealand seashells in color*. 112 p. A. H. & A. W. Reed, Publ., 182 Wakefield St., Wellington, N.Z. US$ 3.95.

RUHNAM, N. W. & HUNTER, P. J. 1970. *Terrestrial slugs*. Hutchinson University Library, Hutchinson & Co. (Publishers), Ltd., 178-202 Great Portland St., London, W1, England. 184 p.

SCHISGALL, Oscar. 1970. *That remarkable creature, the snail*. 64 p. Messner Co., N.Y. US$ 3.95.

WEAVER, Clifton S. & du PONT, John E. 1970. *Living volutes*. A monograph of the Recent Volutidae of the world. 375 p, 79 pls. Delaware Mus. natur. Hist., Greenville, Delaware, U.S.A. US$ 55.00.

Monographs

BRATT, A. D., KNUTSON, L. V., FOOTE, B. A. & BERG, C. O. 1969 (July). *Biology of "Pherbellia" (Diptera: Sciomyzidae)*. Cornell Univ. agr. exp. Stat., Mem. 404: 1-246, figs. 1-84 [predators of mollusks].

CROWLEY, Terence E. & PAIN, Thomas. 1970. A Monographic Revision of the African Land Snails of the Genus *Limicolaria* Schumacher (Mollusca- Achatinidae). *Annales, Musee Royal de l'Afrique Centrale, Tervuren, Belgique, Ser. In-8° (Sci. Zool.)*, (177): 1-61.

FISCHER, Jean-Claude. 1969. *Geologie, paleontologie et paleoécologie du Bathonien au sud-ouest du massif ardennais*. Mém. du Mus. nat. d'Hist. natur. sér. C, 20: 1-319, figs. 1-72, tables 1-9, pls. 1-21.

HERMS, Dietrich. 1969 (1 September). *Marines Pliozän und Pleistozän in Nord- und Mittel-Chile unter besonderer Berücksichtigung der Entwicklung der Mollusken-Faunen*. Zitteliana: Abh. Bayerischen Staatssamm. Paläont. histor. Geol., (2): 1-159, pls. 1-18.

McLEAN, James H. 1969 (October). *Marine shells of southern California*. Los Angeles Co. Mus. natur. Hist., Sci. ser. 24(Zool.11): 104 p. US$ 2.00.

Pamphlets

BURGHARDT, Glenn & Laura. 1969 (Nov.). *West coast chitons*. A collector's guide to West Coast chitons. Spec. publ. 4, San Francisco Aquar. Soc., Inc., 45 p., 4 pls., 7 figs. US$ 4.95.

CANADA, NATIONAL MUSEUMS OF, National Museum of Natural Sciences, The Zoology Division. 1968. *Animal life in Canada today*. 15 p, 1 color pl. The Queen's Printer, Ottawa.

WILSON, Edward C. & BING, Donald E. 1970 (27 February). *Type specimens of fossil Invertebrata in the Los Angeles County Museum of Natural History, exclusive of paleoentomology.* Contr. Sci. Los. Angeles Co. Mus. natur. Hist., (181): 20 p.

Malacological Journals

Archiv für Molluskenkunde, der Senckenbergischen Naturforschenden Gesellschaft, Organ der Deutschen Malakozoologischen Gesellschaft. Sencken-Anlage 25, 6 Frankfurt 1, W. Germany. 1970, 29.5.1970, Band 100, Nummer 1/2, p 1-111; 31.8.1970; Nummer 3/4, p 113-241.

Argamon, Journal of the Israel Malacological Society. P.O., Box 9216, Haifa, Israel. 1970, July, Vol. 1, No. 1, p 1-36.

Basteria, Tijdschrift van de Nederlandse Malacologische Vereniging. Rijksmuseum van Naturrlijke Historie, Leiden, Nederland. 1970, 3-III-1970, Vol. 34, No. 1-2, p 1-42; 15-VIII-1970, No. 3-4, p 43-90; 15-XII-1970, No. 5-6, p 91-154.

Comunicaciones de la Sociedad Malacológica del Uruguay. Casilla de Correo No. 1401, Montevideo, Uruguay. 1969, Abril-Octubre, Vol 2, Nos. 16-17, p 333-405.

Journal de Conchyliolgie. 55 Prince Albert Street, Mosman, N.S.W. 2088, Australia. 1969, 30 décembre, Vol. 107, No. 4, p 137-167; 1970, 31 mars, Vol. 108, No. 1, p 1-34.

Journal of the Malacological Society of Australia. National Museum of Victoria, Russell Street, Melbourne, Victoria 3000, Australia. 1970, 17 August, Vol. 2, No. 1, p 1-96.

La Conchiglia [see next section, under *Shell Collectors Bulletins*].

Lavori della Società Malacologica Italiana. Milano, viale Piceno 39, Italy. 1969, Vol. 6, 360 p.

Malacologia, International Journal of Malacology. Institute of Malacology, c/o Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U.S.A. 1969, December, Vol. 9, No. 2, p 313-508, + 20; 1970, May, Vol. 10, No. 1, p 1-282.

Malacological Review. Society of Experimental and Descriptive Malacology. P.O. Box 801, Whitmore Lake, Michigan 48189, U.S.A. 1970, Vol. 3 (1st part), p 1-102; Vol. 3 (2nd part), p 103-194.

Proceedings of the Malacological Society of London. British Museum (Natural History), Cromwell Road, London, S.W.7, England. 1970, April, Vol. 39, Part 1, p 1-91.

Proceedings of the National Shellfisheries Association. Bureau of Commerical Fisheries Biological Laboratory, Oxford, Maryland 21654, U.S.A. 1969 (1970, June), Vol. 60, p 1-113, i-vi.

Sterkiana. 102 W. Beaumont Road, Columbus, Ohio 43214, U.S.A. 1969, December, No. 36, p 1-50; 1970, March, No. 37, p 1-50; June, No. 38, p 1-50; September, No. 39, p 1-50; December, No. 40, p 1-62.

The Nautilus, The Pilsbry Quarterly Devoted to the Interests of Conchologists. 11 Chelten Rd., Havertown, Pennsylvania 19083, U.S.A. 1970, January, Vol. 83, No. 3, p 77-116; April, Vol. 83, No. 4, p 117-146; July, Vol. 84, No. 1, p 1-36; October, Vol. 84, No. 2, p 37-76.

The Journal of Conchology. Published by the Conchological Society of Great Britain and Ireland. The Eyrie, 58 Teignmouth Road, London, N.W.2, England. 1970, April, Vol. 27, No. 2, p 65-134; October, No. 3, p 135-210.

The Veliger, a Quarterly published by California Malacozoological Society, Inc. 12719 San Vicente Blvd., Los Angeles, California 90049, U.S.A. 1970, 1 Jan, Vol. 12, No. 3, p 239-382; 1 April, No. 4, p 383-488, + i-vi; 1 July, Vol. 13, No. 1, p 1-114; 1 October, No. 2, p 115-206; 1971, 1 Jan., Vol. 13, No. 3, p 207-302.

Venus, The Japanese Journal of Malacology. National Science Museum, Ueno Park, Taito-ku, Tokyo, Japan. 1970, January, Vol. 28, No. 4, p 161-194, + i-iv; May, Vol. 29, No. 1, p 1-34; June, No. 2, p 35-76; August, No. 3, p 77-102.

Shell Collectors' Bulletins

A sheller's directory of clubs, books, periodicals and dealers. 1970. Of sea and shore Publns., P.O. Box 33, Port Gamble, Washington 98364, U.S.A. US$ 1.00.

La Conchiglia, Rivista Mensile delle Meraviglie del Mare, Piazza S. Lorenzo in Lucina, 35 00186 Roma, Italy. Anno 1, 1969, n. 1, marzo, 16 p; n. 2, aprile, 16 p; n. 3, maggio, 16 p; n. 4, giugno, 16 p; n. 5-6, luglio-agosto, 24 p; n. 7, settembre, 16 p; n. 8, ottobre, 16 p; n. 9-10, novembre-dicembre, 24 p; Anno 2, 1970, n. 1(11), gennaio, 16 p; n. 2(12), febbraio, 16 p; n. 3(13), marzo, 16 p; n. 4(14), aprile, 16 p; n. 5(15), May, 16 p; n. 6(16), June, 16 p; n. 7-8(17-18), July-August, 24 p; n. 9(19), September, 16 p; n. 10(20), October, 16 p.

Of sea and shore. 1970 (Summer). Ed. RICE, Thomas C. 1(2): 57-107. P.O. Box 33, Port Gamble, Washington 98364, U.S.A. US$ 1.00.

Oregon Shell News. 1970 (June). 1(1): 4 p. 3440 S.W. Alice No. 39, Portland, Oregon 97219, U.S.A. US$3.00 (U.S.A.), US$ 4.00. (foreign).

Reviews

CUERDA, A. J. 1968. [Review] Borello, A.V.-*Bibliographic index of Argentine stratigraphy*, 1965. Committee of Scientific Research of the Province of Buenos Aires, 638 p, La Plata. *Ameghiniana*, 5(7).

CUERDA, A. J. 1968. [Review] Menendez, C. A. - *Argentine Paleontological Guide*. Part I - section VII. Devonian Floras, 1967. Published by the National Committee of Scientific and Technical Research, 29 p, illustrated, Buenos Aires. *Ameghiniana*, 5(7).

FERGUSON, Frederick F. 1968. The ecology of *Schistosoma mansoni* in Puerto Rico. *Bull. New York Acad. Med.*, 44(3): 231-244.

FERGUSON, Frederick F. 1968. Aquatic weeds and man's well-being. *Hyacinth Control J.*, 7: 7-11.

KAESLER, Roger L. 1970 (September). [Review] *The Tertiary non-marine Mollusca of South America*. - Juan J. Parodiz. Annals of Carnegie Museum, vol. 40. 1969. 242 p. Price not indicated. *Syst. Zool.*, 19(3): 306-307.

MERRILL, Arthur S. & HANKS, Robert W. 1969. The Bureau of Commercial Fisheries Biological Laboratory at Oxford, Maryland, meeting the problems of the shellfisheries. *ASB Bull.*, 16(4): 103-106.

SPARKS, Albert K. 1970 (4 September). [Review] *Principal Diseases of Marine Fish and Shellfish*. Carl J. Sindermann. Academic Press, New York, 1970. xii, 372 p, illus. US$ 17.50. *Science*, 169(3949): 967.

TRUEMAN, E. R. & ANSELL, A. D. 1969. The mechanisms of burrowing into soft substrata by marine animals. *Oceanogr. Mar. Biol. ann. Rev.*, 7: 315-366.

Bibliographies

LA ROCQUE, Aurèle. 1970. *Bibliography of paleontology*. Part 1. Journal of Paleontology, Volumes 1-42. 195 p. Coral Press, Columbus, Ohio, U.S.A.

NOMURA, Hitoshi. 1969 (dezembro). Bibliografia sôbre os recursos marinhos do Brasil. (Suplemento VI). *Pesca e pesquisa*, 2(3): 119-159.

Research and Original Articles

AARDT, W. J. van. 1968. Quantitative aspects of the water balance in *Lymnaea stagnalis* (L.). *Neth. J. Zool.*, 18(3): 253-312.

AARDT, W. J. van & EEDEN, J. A. van. 1969. Bydraes tot die Morfologie van *Bulinus (Physopsis) africanus* (Krauss)(Mollusca: Basommatophora). *Wetenskaplike Bydraes Van Die P.V. vir C.H.O.* [Potchefstroom University for Christian Higher Education, Potchefstroom, Transvaal, Republic of South Africa], Reeks B (Natuurwetenskappe), (5): 1-72.

AMHED, Muzammil & SPARKS, Albert K. 1970. Chromosome number, structure and autosomal polymorphism in the marine mussels *Mytilus edulis* and *Mytilus californianus*. *Biol. Bull.*, 138(1): 1-13.

ANGLADA, R. 1968. Sur la position stratigraphique des gisements types de *Potamides basteroti* (Serres). *Mèm. Soc. géol. min. Bretagne*, 13: 51-53.

ANGLADA, R., DAMIANI, L. & EHRLICH, A. 1968. Sur la présence d'un niveau de diatomées d'âge Burdigalien à Uzès (Gard). *Ann. Fac. Sci. Marseille*, 40: 141-146.

ANSELL, Alan D. 1969. Defensive adaptations to predation in the Mollusca. *Proc. Symp. Moll.*, Mar. biol., Assoc. India, (2): 487-512.

ANSELL, Alan D. 1969. Thermal releases and shellfish culture: Possibilities and limitations. *Chesapeake Sci.*, 10(3&4): 256-257.

ANSELL, A. D. 1970. Boring and burrowing mechanisms in *Petricola pholadiformis* Lamarck. *J. exp. mar. Biol. Ecol.*, 4: 211-220.

ANSELL, Alan D. & TREVALLION, Ann. 1969. Behavioral adaptations of intertidal molluscs from a tropical sandy beach. *J. exp. mar. Biol. Ecol.*, 4: 9-35.

ARTHUR, John W. 1970. Chronic effects of linear alkylate sulfonate detergent on *Gammarus pseudolimnaeus*, *Campeloma decisum* and *Physa integra*. *Water Res.*, 4: 251-257.

ARTHUR, John W. & LEONARD, Edward N. 1970. Effects of copper on *Gammarus pseudolimnaeus*, *Physa integra*, and *Campeloma decisum* in soft water. *J. Fish. Res. Bd. Canada*, 27: 1277-1283.

ASTRE, G. 1969. La notion de reprise de croissance avec variation brusque du test chez les Praeradiolites. *Bull. Soc. Hist. nat., Toulouse*, 105(1-2): 212-216.

AUSTIN, Sheila B. 1968. *Ecological studies on three species of the West Indian intertidal snails Neritidae: Zonation and feeding*. Thesis, Dept. Marine Sci., Univ. Puerto Rico, Mayaguez, P.R. 00708, 70 + ix p., 26 figs., 3 tables.

AZEVEDO, J. Fraga de 1969. Relations biologiques parmi les différentes souches géographiques du complexe *Schistosoma haematobium*. *Bull. Soc. Path. exot.*, 62(2): 348-375.

BABA, Kikutaro & HAMATANI, Iwao. 1970 (November). Occurrences of specimens presumably identifiable with *Stiliger ornatus* Ehrenberg, 1831, at Seto, Kii, Middle Japan (Opisthobranchia: Sacoglossa). *Publ. Seto Marine biol. Lab.*, 43(3): 199-206, pls. 3-4.

BAKER, R. A. 1970 (October). The food of *Riccasdoella limacum* (Schrank) - Acari-Trombidiformes and its relationship with pulmonate mollusks. *J. natur. Hist.*, 4(4): 511-519.

BALEYDIER, C., NICAISE, G. & PAVANS DE CECCATTY, M. 1969. Etat fibrioplastique et différenciation fibrocytaire des cellules conjonctives de *Glossodoris* (Gastropoda Opistobranche). *C.R. Acad. Sci.*, Paris, 269: 175-178.

BARNARD, K. H. 1969 (July). Contributions to the knowledge of South African Mollusca. Part VI. Supplement. *Ann. S. African Mus.*, 47(4): 595-661, pls. 1,2, 30 text figs.

BENSCHOTER, C. A., ALLISON, T. C., BOYD, J. F., BROOKS, M. A., CAMPBELL, J. W., GROVES, R. O., HEIMPEL, A. M., MILLS, H. E., RAY, S. M., WARREN, J. W. & ZEIN-ELDIN, Z. 1970 (31 July). Apollo 11: Exposure of lower animals to lunar material. *Science*, 169(3944): 470-472.

BESSIERE, C., BASTIDE, J. M. & LLABADOR, F. 1969. Sur une cas de teratologie sexuelle chez un Mollusque gastéropode du sousgenre *Cryptomphalus* Moquin-tandon 1885: *Helix* (*Cryptomphalus*) *aspersa* Müller, 1774. *Trav. Soc. Pharm. Montpellier*, 29(4): 253-256.

BINDER, E. 1968. Repartition des Mollusques dans la lagune Ebrié (Côte d'Ivoire). *Cah. O.R.S.T.O.M. Hydrobiol.*, 2(3-4): 3-34.

BINDER, E. 1969. Le pare national du Niokolo-Koba (Sénégal) III. Mollusques terrestres. *Mém. Inst. Fondam. Afrique Noire, IFAN-Dakar*, 84: 69-76.

BINOT, D. & CHÉTAIL, M. 1968. Les mucocytes de manteau d'*Arion rufus* (L.) et leur développement: Histologie et Histochimie. *Ann. Histochim.*, 13: 73-82.

BOETERS, H. D. 1969. *Avenionia brevis* in Deutschland. *Mitt. dtsch. malak. Ges.*, 2(15): 136-138.

BOETERS, H. D. 1969. Die Hydrobiidae Badens, der Schweiz und der benachbarten französischen Départments, Nachtrag (Mollusca, Prosobranchia). *Mitt. bad. Landesver. Naturk. Naturschutz*, 10(1): 175-177.

BOMBACE, G. 1969. Appunti sulla malacofauna e sui fondali circalitorali della penisola de Milazzo. *Quad. Ric. e sperimentatione, Ital.*, 12: 1156.

BOUCAUD, Camou E. 1968. Étude histologique et histochimique de l'appareil digestif de *Sepiola atlantica* d'Orbigny et de *Sepia officinalis* L. *Bull. Soc. linn. Normandie*, 10(9): 220-243.

BOUCAUD, Camou E. 1969. Localisation d'activité amylasiques et protéasiques dans l'appareil digestif de *Sepia officinalis* L. *C.R. Acad. Sci.*, Paris, 269: 2564-2566.

BOURDIER, F., CHALINE, J. & PUISSEGUR, J. J. 1969. Données nouvelles sur les Mollusques et les Micromammifères quaternaires des régions d'Amiens et de Paris. *C.R. Acad. Sci.* Paris, 268: 266-269.

BRISSON, P. 1968. Développement de l'embryon et de ses annexes et étude en culture in vitro chez les Achatines (Gasteropodes Pulmonés). *Arch. Anat. micros. & Morph. exp.*, 57(4): 345-368.

BRISSON, P. 1970. *Contribution à l'étude des corrélations entre les différentes régions de l'appareil génital, par castration, ablation, implantation, chez quelques mollusques gastéropodes pulmonés basommatophores et principalement chez* Bulinus truncatus (*Audouin*). Thèse d'Etat Fac. Sci. Poitiers, (105): A O 4320.

BROWN, Rebecca, ALMODOVAR, Luis R., BHATIA, H. M. & BOYD, William C. 1968. Blood group specific agglutinins in invertebrates. *J. Immunol.*, 100(1): 214-216.

BUTLER, J. Miles, FERGUSON, Frederick F. & OLIVER-GONZÂLEZ, José. 1969. A system for mass producing the snail *Marisa cornuarietis*, for use as a biological control agent of schistosomiasis. *Caribb. J. Sci.*, 9(3-4): 135-139.

BUTOT, L. J. M. 1970. Geschiedenis en stand van de Wijngaardslak in friesland. *Overdruk uit De Levende Natuur*, 73: 40-46.

CARDOT, J. 1969. Recherches sur l'oxydation in vitro de la dapamine par le couer et les ganglions nerveux du Mollusque *Helix pomatia* (L.): la cytochrome-oxydase. *C.R. Soc. Biol. Fr.*, 163(4): 873-877.

CARDOT, J. 1969. Mise en évidence de monoamines dan les fibres nerveuses du coeur des Mollusques *Helix pomatia* Linné et *Archatina marginata* Swainson par l'histochimie de flourescence. *C.R. Acad. Sci.*, Paris, 269: 345-347.

CARNEY, W. Patrick. 1970 (April). *Brachylecithum mosquensis:* infections in vertebrate, molluscan and arthropod hosts. *Trans. Amer. microsc. Soc.*, 89(2): 233-250.

CARRINGTON, A. J. & KENSLEY, B. F. 1969 (July). Pleistocene molluscs from the Namaqualand Coast. *Ann. S. African Mus.*, 52(9): 189-223, pls. 18-29, 11 text figs.

CAUQUOIN, M. 1968. Mollusques récoltés par M. Hoffstetter sur les côtes de l'Equateur et aux îles Galapagos - Tellinidae. *Bull. Mus. nat. Hist. natur. Paris*, 40(1): 167-185.

CAUQUOIN, M. 1968. Mollusques récoltés par M. Hoffstetter sur les côtes de l'Equateur et aux îles Galapagos - Semelidae et Donacidae. *Bull. Mus. nat. Hist. natur. Paris*, 40(3): 574-584.

CAUQUOIN, M. 1969. Mollusques récoltés par M. Hoffstetter sur les côtes de l'Equateur et aux îles Galapagos - Mactridae. *Bull. Mus. Hist. natur.*, Paris, 2ème sér., 40(5): 1019-1030.

CAUQUOIN, M. 1969. Sur une nouvelle espèce de Mactridae du Brésil. *Bull. Mus. Hist. natur.*, Paris, 2ème sér., 40(6): 1175-1178.

CHETAIL, Monique, BINOT, Danièle & BENSALEM, Mounira. 1968. Organe de perforation de *Purpura lapillus* (L.) (Muricide): histochimie et histoenzymologie. *Cah. Biol. mar.*, 9: 13-22.

CHETAIL, Monique & FOURNIÉ, Jean. 1969. Shell-Boring mechanism of the gastropod, *Purpura* (*Thais*) *lapillus:* a physiological demonstration of the role of carbonic anhydrase in the dissolution of $CaCO_3$. *Amer. Zool.*, 9: 983-990.

CHETAIL, Monique & FOURNIÉ, Jean. 1969. Boring mechanism in the *T. lapillus* (Gastropoda, Muricidae): intervention of an enzymatic system in active transport of cations during the destruction of $CaCO_3$. *Amer. Zool.*, 9(4): 551.

CHETAIL, Monique & FOURNIÉ, Jean. 1970. Mécanisme de perforation chez *Thais lapillus* L. (Gasteropode Prosobranche, Muricidé): mise en évidence d'une entrée d'ions calcium durant l'activité de l'organe de perforation. *C.R. Acad. Sci.*, Paris, 271: 118-121.

CHEVALLIER, H. 1968. Mollusques terrestres recueillis dan l'ossuaire chalcolithique de Guiry en vexin. *Bull. Arch. Vexin franc*, 4: 79-80.

CHEVALLIER, H. 1969. Mollusques subfossiles récoltés par Henri Lhote dans le sud oranais et le Sahara. *Bull. Mus. nat. Hist. natur.*, Paris, 41(1): 266-294.

CHEVALLIER, H. 1969. Tous ces Mollusques terrestres. *La vie des Bêtes*, 131: 40-41.

CHEVALLIER, H. 1970. Cycle biologique des grands *Arion* en France. *Sec. Congr. malac. ital., Gênes*, 2 p.

CHEVALLIER, J. P., DENIZOT, M., MOUGIN, J. L., PLESSIS, Y. & SALVAT, B. 1968. Étude géomorphologique et bionomique de l'atoll de Mururoa (Tuamotu). *Cah. Pacif. Fr.*, 12: 1-144. 144.

CHOQUET, M. 1969. *Contribution à l'étude du cycle biologique et à l'inversion du sexe chez* Patella vulgata *Mollusque gastéropode prosobranche*). Thèse Doctorat d'Etat, Lille, d'ordre 185.

CHOQUET, M. & LEMAIRE, J. 1969. Contribution à l'etude de la régénération tentaculaire chez *Patella vulgata* (Gastéropode Prosobranche). *Arch. Zool. exp. et gen.*, 109(3): 319-337.

CHOQUET, M. & LEMAIRE, J. 1969. Étude histologique du complexe tentacule ganglion cérébroide de *Patella vulgata* (Mollusque gastéropode prosobranche). *Bull. Soc. zool. France*, 94(1): 39.

CLAIR, A. & PUISSEGUR, J. J. 1969. Découverte de faunes villafranchiennes entre la vallée de la Saône et Dijon (Côte d'Or). *C.R. Acad. Sci.*, Paris, 268: 3033-3035.

CLARKE, Arthur H. 1970. On *Acroloxus coloradensis* (Henderson) (Gastropoda, Basommatophora) in Eastern Canada. *Publ. Zool.*, (2): 1-13.

CONTI, Franco & TASAKI, Ichiji. 1970 (25 September). Changes in extrinisic fluorescence in squid axons during voltage-clamp. *Science*, 169(3952): 1322-1324.

CVANCARA, Alan M., CLAYTON, Lee, BICKLEY, William B., Jr., JACOB, Arthur F., ASHWORTH, Allan C., BROPHY, John A., SHAY, C. T., DELORME, L. Denis, & LAMMERS, George E. 1971. Paleontology of Late Quaternary Deposits: Seibold Site, North Dakota. *Science*, 171: 172-174.

DAGUZAN, J. 1970. Relation entre l'excrétion de l'acide urique et le cycle de la marée chez *Littorina littorea* (L.) adulte. (Mollusque Mésogastéropode Littorinidae). *C.R. Acad. Sci.*, Paris, 270: 3131-3133.

DAGUZAN, J. 1968. Relation entre l'ecologie et la morphologie de la coquille chez *Thais lapillus* L. (Neogasteropode, Muricidae). *Bull. Soc. Sci. Bretagne*, 52(3-4): 273-280.

DAVIS, George M. 1969. Electrophoretic, immunological and biological properties of a population of *Semisulcospira* transmitting *Paragonimus westermani* in Japan. *Jap. J. Parasitol.*, 18(1): 93-119.

DAVIS, George M. & WERNER, J. Kirwin. 1970. The effect of diet on the fecundity of *Oncomelania hupensis nosophora*. *Jap. J. Parasitol.*, 19(1): 35-53.

DE PORTA, J. 1969. Catalogo sistematico y estratigráfico de los Pectinidos del Neogeno del N.E. de l'España (excepto Baleares). *Acta geol. Hispanica*, 4(5): 135-142.

DOLPH, C. Ivar & HUMPHREY, Donald G. 1970 (April). Chromosomes of the chiton, *Katherina tunicata*. *Trans. Amer. micros. Soc.*, 89(2): 229-232.

DU BOIS, Reymond, MARCUS, E. & MARCUS, E. 1968. *Flabellina engeli*, a new nudibrach from Curaçao. *Beaufortia Pays-Bas*, 200(15): 139-142.

DUPONT, B. & LEVEQUE, Ch. 1968. Boimasse en Mollusques et nature des fonds dans la zone Est du lac Tchad. *Cah. O.R.S.T.O.M. Hydrobiol.*, 2(2): 113-126.

DUSHANE, Helen. 1970. Five new epitonid gastropods from the west coast of the Americas. *Contr. Sci.*, (185): 1-6.

FABRE, Taxy S. & REVEST, E. 1968. Contribution à l'étude d'*Exogyra plicifera* (Dujardin) du Santonien superieur. *Ann. Fac. Sci. Marseille*, 40: 124-134.

FERGUSON, Frederick F., PALMER, Juan R. & JOBIN, William R. 1968. Control of schistosomiasis on Vieques Island, Puerto Rico. *Amer. J. trop. Med. & Hyg.*, 17(6): 858-863.

FISCHER, J. C. 1969. Géologie, paléontologie et paléoécologie du Bathonien au Sud-Ouest du Massif ardennais. *Mém. Mus. nat. Hist. natur., Paris, sér. C.*, 20, 319 p.

FISCHER, J. C. 1970. Deux Bellerophontacés nouveaux de Bolivie. *Bull. Soc. géol. France*, 7(11): 605-608.

FISCHER-PIETTE, E., KEMPF, M. & TESTUD, A. M. 1970. Nouvelles données sur les Veneridae (Mollusques Lamellibranches) du Brésil. *Bull. Mus. nat. hist. natur.*, 2° sér, 41(6): 1543-1553.

FISCHER-PIETTE, E., & TESTUD, A. M. 1970. Sur une espèce peu connue de *Cymatium*, (Mollusques Gastéropodes). *Bull. Mus. nat. Hist. natur.*, 2° *sér*, 41(6): 1554-1556.

FISCHER-PIETTE, E., BLANC, F. & SALAT, F. 1969. Complément aux Mollusques operculés terrestres de Madagascar. *Mém. Mus. nat. Hist. natur., sér. A, Zool.*, 50(2): 109-144.

FRETTER, Vera & PILKERTON, Margaret C. 1970. Prosobranchia- veliger larvae of Taenioglossa and Stenoglossa. *Zooplankton*, Conseil International pour l'exploration da la mer, Sheets 129-132, 26 p.

FREYTET, P. & PLAZIAT, J. C. 1970. Nouveaux éléments de corrélation lithologique et paléontologique entre les formations marines et continentales de l'Eocene inférieur languedocien; le problème de l'Ilerdien continental. *C.R. Acad. Sci.*, Paris, 27: 1076-1079.

GHISOTTI, F. 1968. Scalidae del mediterraneo. *Conchiglie*, 4(9): 151-159.

GHISOTTI, F. & MELONE, G. C. 1970. Catalogo illustrato delle conchiglie marine del Mediterraneo. *Conchiglie*, 6(3-4): 29-45.

GIROD, A. 1969. Ecologia e distribuzione di alcuni molluschi terrestri in Lombardia. *Inst. Lombardo Sci. Lett., Milano, Rend. Sci.*, 103: 67-83.

GIROD, A. 1969. Osservazioni sulla malacofauna dulcacquicola di alcuni fontalini della provincia di Milano. *Natura, Soc. Ital. Sci. Nat. Mus. Civ. St. Natur. Aquario Civ. Milan*, 60(3): 228-229.

GIUSTI, F. 1968. Notulae malacologicae II. Il genere *Oxychilus* nell' arcipelago Toscano. *Atti Soc. tosc. Sci. nat. Pisa*, B(75): 218-235.

GIUSTI, F. 1968. Notulae malacologicae V. Le isole di Gorgona, Gapraia e Giglio. *Atti Soc. tosc. Sci. nat. Pisa*, B(75): 265-324.

GIUSTI, F. 1969. Due nuove specie di *Oxychilus* in grotte della Toscana: *Oxychilus* (*Ortizius*) *tongiorgii* n. sp. et *Oxychilus* (*Ortizius*) *forcartianus* n. sp. (Notulae malacologicae VI). *Mém Mus. Civ. Stor. Nat., Vérone*, 16: 367-374.

GIUSTI, F. 1969. *Oxychilus* (Ortizius) *alliarius* (Miller) nuovo reperto per l'Italia appenninica. (Notulae malacologicae VII). *Mém. Mus. Civ. Stor. Nat., Vérone*, 16: 375-378.

GIUSTI, F. 1969. Nuovi dati sulla posizione sistematica e sulla distribuzione geografica in Italia del genere *Pleuropunctum* (Germain, 1929). Notulae malacologicae III. *Boll. Zool.*, 36(1): 95-98.

GIUSTI, F. 1969. Notulae malacologicae IV. L'isola di Montecristo e lo Scoglio d'Affrica. *Atti Soc. tosc. Sci. natur. Pisa*, B(75): 239-254.

GLYNN, Peter W. 1970. On the ecology of the caribbean chitons *Acanthopleura granulata* Gmelin and *Chiton tuberculatus* Linné: Density, mortality, feeding, reproduction, and growth. *Smithsonian Contr. Zool.*, (66): 1-21.

GODAN, D. 1970. Vulgärnamen von Schnecken im Pflazenschutz (deutsch, englisch, französisch, holländisch, italienisch, spanisch). *Z. Pflazenkrankheiten Pflanzenschutz*, Stuttgart, 77(1): 38-58.

GOLIKOV, A. N. & SCARLATO, O. A. 1970. Abundance, dynamics and production properties of populations of edible bivalves *Mizuhopectin yessoensis* and *Spisula sachalinensis* related to the problem of organization of controllable submarine farms at the Western shores of the Sea of Japan. *Helgoländer wiss. Meeresunters.*, 20: 498-513.

GRAMBAST, L., RAT, P. & REY, R. 1969. Sur la stratigraphie des formations lacustres paléogènes à l'Est de Dijon. *C.R. Soc. géol.*, 6: 200.

GROSSU, A. V. 1969. Studiul populatiilor si polimorfismul la *Hydrobia* (*Potamopyrgus*) *jenkinsi* (Smith) din complexul Razelm. *Cercetari de Ecol. anim., Lucrările primeisesiuni stiintifice pe țară de Ecol. anim.*, 23-28 *mai* 1966, Bucarest, p 131-138.

GROSSU, A. & NEGREA, A. 1968. Révision des espèces du genre *Argna* Gosman (Gastropoda, Pulmonata) de Roumanie et la description de quelques nouvelles unités taxonomiques. *Trav. Mus. Hist. natur. Grigore Antipa*, Bucarest, 8: 721-734.

GROSSU, A. & RIEDEL, A. 1968. Beitrag zur Kenntnis der Zonitidae (Gastropoda) Rumäniens. *Trav. Mus. Hist. natur. Grigore Antipa*, Bucarest, 8: 735-748.

GUILLIEN, Y. & PUISSEGUR, J. J. 1969. Géomorphologique et Malacologie de quelques dépôts de pente charentais. *C.R. Acad. Sci.*, Paris, 268: 24-27.

HEROLD, P. P. 1969. L'activité et les échanges respiratoires du coeur isolé de l'escargot (*Helix pomatia* L.) soumis à différents inhibiteurs métaboliques. *C.R. Séances Soc. Biol.*, 163(4): 877.

HERTLIN, Leo G. 1969. Fossiliferous boulder of early Tertiary age from Ross Island, Antarctica. *Antarctic J. United States*, 4(5): 199-200.

HIS, E. 1970. L'émission des gamètes chez l'huître portugaise (*Crassostrea angulata* Lmk.). *Rev., Trav. Inst. Pêches marit.*, 34(1): 17-22.

INDELICATO, I. & STREIFF, W. 1969. Étude statistique et cytophotométrique de la dimégalie des spermatozoïdes chez *Patella coerula* L., Mollusques; Gastéropodes, Prosobranches. *C.R. Acad. Sci.*, Paris, 268: 2091-2094.

JOBIN, William R. & BERRÍOS-DURÁN, Luis A. 1970. Cost of harvesting and spreading *Marisa cornuarietis* for biological control of *Biomphalaria glabrata* in Aibonito, Puerto Rico. *Bull. wld. hlth. Org.*, 42: 177-179.

JOBIN, William R., FERGUSON, Frederick F. & PALMER, Juan R. 1970. Control of schistosomiasis in Guayama and Arroyo, Puerto Rico. *Bull. wld. hlth. Org.*, 42: 151-156.

JOBIN, William R. & RUIZ-TIBEN, E. 1968. Bilharzia and patterns of human contact with water in Puerto Rico. *Bol. Asco. médica de P. Rico*, 60(6): 279-284.

JOURDAN, F. & NICAISE, G. 1970. Cytochimie ultrastructurale de la serotonine dans le système nerveux central de l'aplysie. *Soc. Franç. Microsc. Electron*, Paris, p 677-678.

KAWASHIMA, Kenjirô & HAMAJIMA, Fisanori. 1970. A new molluscan host for *Paragonimus ilktsuenensis* Chen, 1940 in Is. Amami-Oshima, Kagoshima Prefecture, Japan. *Jap. J. Parasit.*, 19(2): 199-205.

KENSLEY, Brian & PENRITH, Mary-Louise. 1970 (April). New records of Mytilidae from the northern South West Africa Coast. *Ann. S. Afr. Mus.*, 57(2): 15-24.

KERMAREC, Labisse N. 1968. Note sur des *Aporrhais pespelicani* L. (Mollusque gastéropode marin) provenant de l'Adriatique et recueillis vivants à Ostende. *Bull. Mus. natn. Hist. natur.*, 39(5): 968-969.

KLAPPENBACH, Miguel A. 1968. Notas Malacologicas, 1. 1) *Haliotis pourtalesii* Dall, 1881 en la Costa Brasileña de San Pablo. *Com. Zool. Mus. Hist. natur. Montevideo*, 9 (122): 1-7.

KLAPPENBACH, Miguel A. 1970. Notas Malacological, II. 1)*Chlamys lischkei* (Dunker, 1850) Tiene Prioridad Sobre *Chlamys patriae* (Doelle-Jurado, 1918) (Pelecypoda). *Com. Zool. Mus. Hist. natur. Montevideo*, 10(132): 1-7.

KLAPPENBACH, Miguel A. 1970. A new species of *Eupera* (Mollusca; Pelecypoda) from Haiti. *Proc. biol. Soc. Wash.*, 82(63): 825-828.

KLAPPENBACH, Miguel A. & SCARABINO, Victor. 1968. Los generos *Nuculana* Link, 1807, y *Adrana* H. & A. Adams, 1858 (Moll. Pelecypoda) en Aguas Atlanticas Sudamericanas, con descripcion de una neuva especie. *Rev. Inst. Invest. Pesqueras*, 2(2): 237-247.

KOPPENHHEFFER, Tom L. & READ, Kenneth R. H. 1968. Radular muscle myoglobin of the gastropod mollusc *Nerita peloronta* L. *Comp. Biochem. Physiol.*, 28: 753-756.

KOSUGE, Sadao. 1969. Fossil mollusks of Oahu, Hawaii Islands. *Bull. nat. Sci. Mus.*, Tokyo, 12(4): 783-794.

KOSUGE, Sadao. 1970. Gross anatomy of *Harpeola kurodai* Kawamura (Gastropoda, Mollusca). *Bull. nat. Sci. Mus.*, Tokyo, 13(2): 129-134.

KŘIŽ, J. 1969. Genus *Butovicella* Kříž, 1965 in the Silurian of Bohemia (Bivalvia). *Sbornik Geol. Ved., paleolontol.*, 10: 105-139.

LAMOTTE, M. 1969. Relations entre deux couples de caractères dépendant de deux locus étroitement liés: les caractères jaune/rose et avec bandes/sans bandes dans les populations naturelles de *Cepaea nemoralis* (Mollusques Hélicidés) du Sud de l'Aquitaine. *C.R. Acad. Sci.*, Paris, 268: 2476-2478.

LE GALL, J.Y. 1969. Exploitation des populations de Praires *Venus verrucosa* (Mollusque Lamellibranche Veneridae) sur les côtes de Bretagne. *Trav. Fac. Sci. Rennes, Sér. Océanogr. biol.* 2, 51 p.

LEVEQUE, Ch. 1968. Biologie de *Bulinus forskalii* (Mollusque, Gasteropode) de la région de Fort-Lamy (Tchad). *Cah. O.R.S.T.O.M. Hydrobiol.*, 2(2): 79-90.

LLABADOR, F. 1969. Sur une hélicelle des hautes plaines steppiques du Nord-Ouest de l'Afrique: *Helicella* (*Xerophila*) *lemoinei* (Debeaux) Kobelt, 1882. *Trav. Soc. Pharm. Montpellier*, 29(1): 5-20.

LOGVINENKO, B. M. & STAROBOGATOV, Ya. I. 1968. Kinds of Mollusca. In: *Atlas of the Invertebrates of the Caspian Sea*, p 308-385.

LONG, David C. 1970. *Arion intermedius* Normand, an introduced slug in Victoria. *Vict. Natur.* 87(6): 170-171.

LONGWELL, Crosby A. & STILES, S. S. 1970. The genetic system and breeding potential of the commercial American oyster. *Endeavor*, 29(107): 94-99.

LOOSJES, F. E. & NEGRA, Alexandrina. 1968. Contributions to the distribution of the Clausiliidae (Gastropoda, Pulmonata) in the Karst regions of Romania. *Zool. Meded.*, 43(4): 41-55.

LOŽEK, Vojen. 1969. Über die malakozoologische Charakteristik der pleistozänen Warmzeiten mit besonderer Berücksichtigung des letzten Interglazials. *Ber. deut. Ges. geol. Wiss.*, A, Geol. Paläont., 14(4): 439-469.

LUCAS, Albert. 1970. Conchyliculture Experimentale. *Publ. Centre nat. Expl. Oceans*, 70-01: 1-75.

LUCAS, M. 1969. Les collections de coquillages et d'invertébrés marins. Quelques indications pour les débutants. *Extr. Bull. Les Natur. Belges*, Bruxelles, 50(6): 314-324.

LUCAS, M. 1969. Mollusques venimeux. *Extr. Bull. Natur. Belges*, Bruxelles, 51(4): 213-222.

LUDBROOK, Nellie H. 1969. The genus *Miltha* (Mollusca: Bivalvia) in the Australian Cenozoic. *Trans. roy. Soc. S. Austr.*, 93: 55-63.

MAPSTONE, G. M. 1970. Feeding activities of veligers of *Nassarius reticulatus* and *Crepidula fornicata* and the use of artificial foods in maintaining cultures of these larvae. *Helgoländer wiss. Meeresunters*, 20: 565-575.

MARAZANOF, F. 1969. Contribution à l'etude ecologique des Mollusques des eaux douces et saumâtres de Camargue I - Milieux espèces. *Ann. Limnol.*, 5(3): 201-323.

MARCUS, Ernst & MARCUS, Eveline. 1970. Opisthobranch mollusks from the southern tropical Pacific. *Pacific Sci.*, 24(2): 155-179.

MAURY, A. 1968. Note sur *Assemania grayana* (Fleming). *Extr. Bull. Soc. Géol. Normandie et Amis Mus. du Havre*, 57: 46-54.

MCLEAN, James H. & POORMAN, Leroy H. 1970. Reinstatement of the turrid genus *Bellaspira* Conrad, 1868 (Mollusca: Gastropoda) with a review of the known species. *Contrib. Sci.*, (189): 1-11.

MICHA, J.-C. 1969. Étude qualitative des associations d'invertébrés de l'Ourthe liégeoise. *Ann. Soc. roy. Zool. Belg.*, 99(4): 215-236.

MIENIS, H. K. 1970. *Theba pisana* (Müller, 1774) in citris plantations of Netser Sereni. *De Kreukel*, Amsterdam. 6(3): 34-35.

MOREAU, J. 1969. La flore planctonique et benthique des claires à huîtres et l'evolution pigmentaire de *Navicula ostrearia*. *Cté du plancton*, 3 p.

MOREAU, J. 1969. La composition hivernale des eaux des claires à huîtres en ions Mg^{++} et Ca^{++} en rapport avec la teneur en phosphore mineral. *Cté de l'amélioration des pêches*, 2 p.

MOREAU, J. 1969. Le verdissement dans le claires à huîtres et l'evolution corrélative des chlorophylles a et c. *Cté des Crustacés, Coquillages et benthos*, 3 p.

MOREAU, J. 1969. Introduction aux recherches sur la présence de substances hydrocarbonées et lipoprotéiques dan les claires à huitres et sur leur relation éventuelle avec la pigmentation de *Navicula ostrearia* B. *Rev. Trav. Inst. Pêches marit.*, 33(3): 333-342.

NEGREA, Alexandrina & RIEDEL, Adolf. 1968. Eine neue unterirdische Zonitiden-Art und-Gattung (Gastropoda) aus Rumänien. *Ann. Zool.*, 26(5): 209-215.

NICAISE, G. 1969. Detection histochimique de cholinestérases dans les cellules gliales et interstitielles des Doridiens. *C.R. séances Soc. Biol.*, Paris, 163(12): 2600.

NICAISE, G. 1970. Cutochimie ultrastructurale des granules glio-interstitiels d'un Gastéropode. *Soc. Franç. Microsc. Electron*, Paris, p 475-476.

OBERHOLZER, G. & VAN EEDEN, J. A. 1969. Studies on the morphology and histology of *Burnupia mooiensis* (Walker) (Mollusca, Basommatophora, Ancylidae). *Wetenskaplike Bydraes Van Die P.U. vir C.H.O.* [Potchefstroom University for Christian Higher Education, Potchefstroom, Transvaal, Republic of South Africa] Reeks B (Natuurwetenshkappe), (7): 1-69.

OKUTANI, Takashi & MCGOWAN, John A. 1969. Systematics, distribution and abundance of the epiplanktonic squid (Cephalopoda, Decapoda) larvae of the Californian Current April, 1954-March, 1957. *Scripps Inst. Oceanogr. Bull.* 14: 90 p. Univ. California Press, Berkeley, U.S.A.

ORFILA, C. & STREIFF, W. 1969. Étude de la teneur en A.D.N. des spermatozoïdes polygaliques chez *Crepidula fornicata* L. Mollusque, Gastéropode, Prosobranche. *C.R. Acad. Sci.*, Paris, 268: 1948-1950.

PAJAUD, D. & PHILIP, J. 1969. Un biotope commum aux Rudistes et aux Thécidées dans le santonien de Provence. *C.R. Somm. S G F*, 2: 35.

PALMER, Juan R., COLON, Aida Z., FERGUSON, Frederick F. & JOBIN, William R. 1969. The control of schistosomiasis in Patillas, Puerto Rico. *Public Hlth. Reps.*, 84(11): 1003-1007.

PERREAU, M. & POMEROL, Ch. 1969. Étude paléontologique et paléoécologique du rivage bartonien d' Atteinville (val d' Oise). *Bull. Soc. Géol. Fr.*, 2: 13-27.

PEZZOLI, E. & TOFFOLETTO, F. 1968. Una nuova specie di *Paladilhia* delle Prealpi Lombarde (Gastropoda, Prosobranchia). *Arch. Molluskenk.*, 98(3-4): 117-120.

PHILIP, J. 1968. Nouvelles observations stratigraphiques au toit de la bauxite de la région de Brignoles (Var). Implications paléogéographiques. *C.R. Soc. géol. Fr.*, 7: 216-217.

PILKINGTON, M. C. & FRETTER, V. 1970. Some factors affecting the growth of prosobranch veligers. *Helgoländer wiss. Meeres.*, 20: 576-593.

PINTER, L. 1969. Neue Mollusken aus Bulgarien (Gastropoda: Helicidae). *Acta Zool. acad. sci. hungar.*, 15(1-2): 91-96.

PLAZIAT, J. C. 1970. Huîtres de Mangrove et pueplements littoraux de l'Eocene inférieur des Corbières. *Géobios*, 3(1): 7-27.

PRETORIUS, S. J. & VAN EEDEN, J. A. 1969. Some aspects of the morphology of *Lymnaea natalensis* Krauss (Mollusca: Basommatophora). *Wetenskaplike Bydraes Van Die P.V. vir C.H.O.* [Potchefstroom University for Christian Higher Education, Potchefstroom, Transvaal, Republic of South Africa], Reeks B (Natuurwetenskappe), (6): 1-111.

RAVERA, O. 1969. Molluscs in Radiobiology. *Proc. Symp. Moll.*, Mar. biol. Assoc. India, (2): 456-462.

RAVERA, O., DE BERNARDI, R, & OREGIONI, B. 1969. Il Simposio sui "Problemi di ecologia dei Molluschi dulcicoli" Milano, II-V-1969. *Soc. Ital. Sci. natur.*, 60(3): 226-227.

RAVERA, O., GADDI, G. & GIANNONI, L. 1969. Different radiosensitivity of male and female germ cells of *Physa acuta* Draparnaud (Gastropoda, Basommatophora). *Proc. Symp. Moll.*, Mar. biol. Assoc. India, (2): 439-440.

REY, R. 1969. Le niveau à *Cepea subsulcosa* de Moulins. *Rev. Sci. Bourbonnais Centre Fr.*, p 34-55.

RHOADS, Donald C. & YOUNG, David K. 1970. The influence of deposit-feeding organisms on sediment stability and community trophic structure. *J. Mar. Res.*, 28(2): 150-178.

RICHARD, A. 1969. The part played by temperature in the rhythm of formation of markings on the shell of cuttlefish (*Sepia officinalis* L.) (Cephalopoda Mollusca). *Experientia*, 25: 1051.

RICHARD, A. & DECLEIR, W. 1969. Mise en évidence d'une variation des protéines sanquines au cours des premières semaines de vie postembryonnaire chez *Sepia officinalis*, (Mollusques Cephalopodes). *C.R. Acad, Sci.*, Paris, 268: 107-110.

RUIZ-TIBEN, Ernesto, PALMER, Juan R. & FERGUSON, Frederick F. 1969. Biological control of *Biomphalaria glabrata* by *Marisa cornuarietis* in irrigation ponds in Puerto Rico. *Bull. wld. hlth. Org.*, 41: 329-333.

RUTKOWSKI, Roman B. & DAVIS, George M. 1970. Trypsin inhibitors in mesogastropod foot-muscle extracts. *Jap. J. Parasit.*, 19(2): 171-181.

SACCHI, C. F. & GIROD, A. 1968. I Molluschi d'acqua dolce di alcune stazioni presso Terracina. Ricerche ecologiche e faunistiche. *Bol. Pesca Piscic. Idrobiol.*, 23(1): 5-32.

SEFRIEL, U. 1969. Ecological segregation, polymorphism and natural selection in two intertidal gastropods of the genus *Nerita* at Elat (Red Sea, Istael). *Israel J. Zool.*, 18(2-3): 205-231.

SILBERZAHN, N., STREIFF, W., LE BRETON, J., & LUBET, P. 1969. Rôle du complexe pedio-pleural dans la régression du pénis chez *Crepidula fornicata* Phil et chez *Littorina littorea* L. *Gen. Comp. Endocrinol.*, 13(3): 134.

STERN, G. 1969. Bilan énergétique de la limace *Arion rufus* (Mollusque Pulmoné) en periode de croissance. *C.R. Acad. Sci.*, Paris, 269: 1015-1018.

STREIFF, W. & LUBET, P. 1969. Influence des ganglions cérébroïdes dans le déterminisme du cycle sexuel d'un Mollusque hermaphrodite *Crepidula fornicata*. *Gen. Comp. Endocrinol.*, 13(3): 139.

TERWILLIGER, Robert C. & READ, Kenneth R. H. 1969. The radular muscle myoglobins of the amphineuran mollusc, *Acanthopleura granulata* Gmelin. *Comp. Biochem. Physiol.*, 29: 551-560.

THIRIOT-QUIEVREUX, C. 1969. Caracteristiques morphologiques des Véligères planctoniques de gastéropodes de la région de Banyuls-sur Mer. *Vie et Milieu*, 20(2B): 333-366.

THIRIOT-QUIEVREUX, C. 1969. Organogenèse larvaire du genre *Atlanta* (Mollusque hétéropode). *Vie et Milieu*, 20(2-A): 347-396.

THOMPSON, Fred G. 1969. Some Mexican and Central American Land Snails of the Family Cyclophoridae. *Zoologica*, 54(2): 35-77.

VICENTE, Nardo. 1969. Étude histologique et histochimique du système nerveux central, des rhinophores et de la gonade chez les gastéropodes opisthobranches. *Tethys*, 1(3): 833-874 .

VICENTE, Nardo. 1969. Corrélations neuroendocrines chez *Aplysia rosea* ayant subi l'ablation de divers ganglions nerveux. *Tethys*, 1(3): 875-900.

VOVELLE, J. 1969. Donnés histochimiques et cytologiques sur l'élaboration de l'opercule chez les Turbinidae. *Bull. Soc. Zool. Fr.*, 94(3): 501.

WITTINE, Arthur H. 1969. Distribution of unionids in Hinkley Creek, Portage County, Ohio. *Compass of Sigma Gamma Epsilon*, 46(3): 142-149.

WORK, Robert C. 1969 (September). Systematics, ecology, and distribution of the mollusks of Los Roques, Venezuela. *Bull. mar. Sci.*, 19(3): 614-711, 4 figs.

YASURAOKA, Kazuo, HOSAKA, Yukio & KOMIYA, Yoshitaka. 1968. Some laboratory investigations on Yurimin P-99 as an experiamental molluscicide. *Jap. J. Parasit.*, 17(5): 376-381.

YOCHELSON, Ellis. 1969. "Stenothecoidea," a proposed new class of Cambrian Mollusca. *Lethaia*, 2(1): 49-62, figs. 1-5. Oslo.

YOUNG, David K. 1969. *Okadaia elegans*, a tube-boring nudibranch mollusc from the Central and West Pacific. *Amer. Zool.*, 9: 903-907.

ZEISSLER, Hildegard. 1969. Möglichkeiten und Probleme Quantitativer Arbeit mit fossilen Mollusken, dargestellt an einem Beispiel aus dem Ehringsdorfer Travertin (DDR). *Ber. deutsch. Ges. geol. Wiss. - A Geol. Paläont*, 14(4): 507-531.

ZEISSLER, Hildegard. 1969. Zum Unterschied in der Zusammensetzung der Molluskenfaunen benachbarter Nord- und Südhänge. I. Der Kellnersberg bei Bad Berka. *Malak. Abh. Mus. Tierkde. Dresden*, 2(19): 249-259.

ZEISSLER, Hildegard. 1969. Zum Unterschied in der Zusammensetzung der Molluskenfaunen benachbarter Nord- und Südhänge. II. Sommer- und Winterstein bei Hallungen im Hainich. *Malak. Abh. Mus. Tierkde. Dresden*, 2(20): 261-278.

Newsletters

Achatina. 1970 (I-VI). A newsletter of African non-marine malacology. No. 1. Section des Invertébrés non-Insectes, Musée Royal de l'Afrique Centrale, 1980 Tervuren, Belgique. p 1-18.

American Malacological Union Newsletter. Fall, 1970. American Museum of Natural History, 79th Street & Central Park West, New York, N.Y., U.S.A., 9 p.

Australian Newsletter. 1970 (31st January). No. 8 (New Series). Malacological Society of Australia. The Australian Museum, 6-8 College St., Sydney, N.S.W. 2000, Australia. p 1-14.

Australian Newsletter. 1970 (30th April). No. 9 (New Series). Malacological Society of Australia. The Australian Museum, 6-8 College St., Sydney, N.S.W. 2000, Australia. p 1-12.

Australian Newsletter. 1970 (31st July). No. 10 (New Series). Malacological Society of Australia. The Australian Museum, 6-8 College St., Sydney, N.S.W. 2000, Australia. p 1-12.

Bulletin Mensuel de l'Association Belge de Malacologie, Conchyologie et Paleontologie. 1970. 3(1); 3(2); 3(3); 3(4).

Correspondentieblad van de Nederlandse Malacologische Vereniging. No. 137. 1970 (april). c/o Natuurhistorisch Museum, Kastanjesingel 107, Rotterdam-12, The Netherlands. p 1511-1520, 1 fig.

Correspondentieblad van de Nederlandse Malacologische Vereniging. No. 138. 1970 (november). c/o Rijksmuseum van Natuurlijke Historie, Raamsteeg 2, Leiden, The Netherlands. p 1521-1538.

Correspondentieblad van de Nederlandse Malacologische Vereniging. No. 139. 1970 (december). c/o Rijksmuseum van Natuurlijke Historie, Raamsteeg 2, Leiden, The Netherlands, p 1539-1576.

Mitteilungen der Deutschen Malakozoologischen Gesellschaft. Band 2, Nummer 16. April 1970. Schloss Rosenstein, Stuttgart 1, W. Germany. p 143-192.

Mitteilungen der Deutschen Malakozoologischen Gesellschaft. Band 2, Nummer 17. Juli 1970. Schloss Rosenstein, Stuttgart 1, W. Germany. p 193-217.

Molluscan Digest. 1971 (1 January). Vol. 1, No. 1, 8 p. 2962 Balboa Avenue, Oxnard, California 93030, U.S.A.

Opisthobranch Newsletter. 1970 (September 1). Vol. 2, No. 9, p 35-38. 110 Cuyama Avenue, Pismo Beach, California 93449, U.S.A.

Pesca e pesquisa. 1969 (Junho). Vol. 2, No. 2, p 41-104. Superintendência do Desenvolvimento da Pesca, Ministério da Agricultura, Rio de Janeiro, Brasil.

Pesca e pesquisa. 1969 (Set./Dez.). Vol. 2, No. 3, p 105-159. Superintendência do Desenvolvimento da Pesca, Ministério da Agricultura, Rio de Janeiro, Brasil.

SOCIETE FRANCAISE DE MALACOLOGIE. 1970 (Avril). *Complement bibliographie* 1968. Liste bibliographique no. 2. 7 p. 55, rue Buffon, Paris 5e, France.

SOCIETE FRANCAISE DE MALACOLOGIE. 1970. *Annuaire*. 57 p. 55, rue Buffon, Paris 5e, France.

THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND. 1970 (June). *The Conchologists' Newsletter*. No. 33: 146-158.

THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND. 1970 (September). *The Conchologists' Newsletter*. No. 34: 159-176.

Technical Comments and Research Notes

BABA, Kikutaro. 1970. List of the Gastropteridae and Runcinidae from Japan. *Collecting and Breeding*, 32(2): 46-48. [In Japanese]

MALACOLOGICAL REVIEW

MALACOLOGICAL REVIEW is published as a scientific periodical and may contain review articles on various aspects of malacology, experimental and descriptive papers on mollusks, information on current publications, malacological announcements of special interest, etc. *MALACOLOGICAL REVIEW* is affiliated with the following malacological publications:

[illegible]
[illegible]
Comunicaciones de la Sociedad Malacológica del Uruguay
[illegible]
The Echo
[illegible]
Journal of the Malacological Society of Australia
[illegible]
[illegible]
Tierkunde in Dresden
Occasional Papers on Mollusks
Sterkiana
Venus

[illegible]

Institute of Malacology
Malacological Society of Australia
Malacological Society of Japan
[illegible]
Sociedad Malacológica del Uruguay
[illegible]
The Israel Malacological Society
Western Society of Malacologists

[illegible] ordering are given below:

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
U. S. A.	Sydney South, Australia	Hiroshima-ken, Japan

[illegible]	[illegible]
MALACOLOGICAL REVIEW	*MALACOLOGICAL REVIEW*
c/o Department of Zoology	c/o Marine Biological Station
Ain Shams University	of Annamalai University
Abbassia, Cairo	Porto Novo, Tamilnadu
U. A. R.	India

MALACOLOGICAL REVIEW

RECEIVED
FEB 2 1972

4

MALACOLOGICAL REVIEW

MALACOLOGICAL REVIEW

4

1971

MALACOLOGICAL REVIEW

VOLUME 4, Number 2 1971

* * * * * *

CONTENTS

Research Articles

Annual fluctuations in the water content of desert snails.
Y. YOM-TOV 121

Mussel fauna found in Fort Loudoun reservoir, Tennessee River, Knox County, Tennessee in December 1970. B. G. ISOM. 127

Taxonomic studies of the land snail family Succineidae.
C. M. PATTERSON 131

Brief Communications

A biologist's look at the history of Muscle Shoals (Mussel Shoals).
B. G. ISOM 203

A note on *Martesia striata* (Pholadidae) tunnelling into plastic piping in Hong Kong. B. MORTON 207

Chromosome numbers of Hawaiian Lymnaeidae. J. B. BURCH and C. M. PATTERSON 209

Miscellanea

H. B. Herrington honored for his sphaeriid work. 211

Meeting Notices

Symposium on Indian Estuarine Biology 213
The Israel Malacological Society, Second Annual Symposium 213
Société Française de Malacologie, Congress at Besançon in 1972 213
Western Society of Malacologists, Fifth Annual Meeting 213
American Malacological Union, Thirty-eighth Annual Meeting 213
Mollusk Seminar at the University of Michigan 213

(continued)

Malacological Societies' News

American Malacological Union, Thirty-seventh Annual Meeting 214
Mollusk Seminar, Ann Arbor, Michigan 214
Unitas Malacologica Europaea, Forth European Malacological Congress. 214

Announcements

Volumes, issues and publication dates of *Malacological Review* 216
Delay in mailing *Malacological Review*, Vol. 3, second part 216
New subscription price for *Malacological Review* 216
List of European Malacologists, 1971 216
Graduate study in malacology at the University of Michigan 216

Book Reviews

Biology of Intertidal Animals, reviewed by J. N. CATHER 217
The Systematics and Biology of Abyssal and Hadal Bivalvia, reviewed by K. J. BOSS 219
Superfamilia Unionacea, reviewed by W. H. HEARD 221
Pleistocene Mollusca of Ohio, reviewed by B. B. MILLER 223

Contents of Malacological Periodicals, 1970 (cont.) 225
Author index for malacological periodicals, 1970 (cont.) 256

Contents of Malacological Periodicals, 1971 265
Author index for malacological periodicals, 1971 273

Publications 277

Index 283

* * * * * *

Malacological Review, 1971, 4: 121-126

ANNUAL FLUCTUATIONS IN THE WATER CONTENT OF DESERT SNAILS[1]

Yoram Yom-Tov[2]

ABSTRACT

The annual fluctuations in water content were examined in 2 species of desert snails. Although these snails respond to some climatic factors, the annual fluctuations are relatively small. There is some evidence that the snails burn food stores to improve their water balance during aestivation in summer.

INTRODUCTION

The survival of snails in hot deserts has always been an enigma (Schmidt-Nielsen, 1969), since most species of Gastropoda occur in marine or humid environments. In the desert, these animals face hostile conditions such as intense solar radiation producing high ground temperatures, high evaporation rates and low relative humidities. In summer, when these conditions are most extreme, desert snails aestivate. This aestivation can continue for very long periods (Mendelssohn, 1963).

This paper shows how 2 species of desert snails maintain their water balance during the year and how it is affected by some climatic factors.

The snails *Trochoidea* (*Xerocrassa*) *seetzeni* Charpentier 1847 and *Sphincterochila boissieri* Charpentier 1847 are sympatric in the the Negev Desert of Israel (Yom-Tov, 1970). Adult specimens of *T. seetzeni* each weigh about 1.6 g, of which the soft-body weight is about 60%. The shell is white, sometimes with brownish stripes. This species feeds mainly on higher plants and sometimes on lichens (Yom-Tov & Galun, 1971). In summer, the snails aestivate with their calcareous epiphragms attached to shrubs. Adult *S. boissieri* weigh about 4.3 g each, with the soft-body constituting about 50% of this weight. The shell is white and thicker than that of *T. seetzeni*. *S. boissieri* feeds mainly on organic matter in the soil, lichens and algae (Yom-Tov & Galun, 1971). In summer, they bury themselves to a depth of 1-5 cm (measured from the snail's vertex). The soft body parts of both species contain 80-90% water. Snails are a favorite food of some desert rodents (Shkolnik & Borut, 1969; Yom-Tov, 1970), whose water balance they improve. Additional data on the snail's weight and measurements are given in Yom-Tov (1971).

The work reported here was conducted in a dry valley (wadi) of Israel's Negev Desert. This valley is one of several formed by erosion on the northwestern slope of the Hatira anticline (long. E34°50'; lat. N30°50'), 500 m above sea level. The climate is arid: the mean annual rainfall is about 100 mm, with great fluctuations (±40%) from year to year; 15-25 rainy days per annum, mostly during 5 winter months (November-March) (Kazenelson, 1959). Solar radiation is intense and reaches the ground 98% of possible sun hours in summer and 50% in winter (Ashbel, 1966). As a result, the total average radiation is 185 kg cal. per hori-

[1] From a Ph.D. Thesis submitted to the Senate of the Tel-Aviv University.

[2] Present address: Culterty Field Station, Newburgh, Aberdeenshire, Scotland.

zontal sq. cm (Ashbel et al., 1965). Soil temperature can rise to 70°C at noon on a summer day. Relative humidity is low and decreases to less than 10% during several days in summer. Evaporation is high: the mean annual evaporation is about 2,600 mm Pitche. Additional data on the Negev climate is given in Table 1.

TABLE 1. Meteorological data for the Negev Desert

	Temperature[1] °C			% Relative humidity[1]			Daily evaporation[2] in mm Pitche
	Mean	Max.	Min.	Mean	Max.	Min.	
January	11.9	17.1	6.8	70	78	55	3.5
July	27.2	34.9	19.5	59	68	40	11.0

[1]Data from Ashbel (1952).

[2]Data from Friedman (1969).

MATERIALS AND METHODS

Snails were collected every 2 to 4 wks. between October 1967 and October 1969. Four groups of snails were collected each time: 2 groups each of *Sphincterochila boissieri* and *Trochoidea seetzeni* from the southern and northern slopes. A total of 46 groups of each species were collected from each slope. Every group contained 21 specimens. This number was chosen since a preliminary study showed that the standard deviation of the percentage of water content in the body was always less than 10%. It was also found that there was no difference in this respect between small and large snails. The snails were put in cloth bags and brought to the laboratory within 4 hrs. Here they were transferred to polyethylene bags, which were hermetically sealed and frozen at -15°C.

To determine water content, the snails were defrosted in the closed bag and brought to room temperature. Then the condensed water was wiped off the shells and they were weighed on an H6T Mettler balance to an accuracy of 0.1 mg. The soft parts were removed with pincers. In most cases there was no need to break the shells, but when the shells had to be broken all parts were carefully collected. The shell and the soft-body parts were dried separately for 24 hrs. in an oven at a temperature of 105°C and then weighed. The water content of each snail was calculated by subtracting the dry weight of the shell plus the soft-body parts from that of the whole snail. The weight of the soft parts of a snail was considered to equal its whole weight less that of the dried shell. The percentage of water in the soft parts of every snail was calculated, and means for every collection are given in Fig. 1.

T-tests were made to see whether there were significant differences in the percentage of water between the populations on the southern and northern slopes in the different seasons and within every slope between different seasons. All data of both snail species were used in these tests.

An attempt was made to correlate the percentage of water in the snails with some meteorological data which were collected at Sde Boker, 3 km from the research area. These data are very similar to those obtained in the research area itself (Friedman, 1969). All the utilized meteorological data were means for 10 days before each collection (Fig. 2). These meteorological data were recorded in a regular meteorological station, 2 m above ground. The data used in this work were daily temperature, (mean, maximum, minimum), daily relative humidity (mean, maximum, minimum), evaporation (Pitche method and water surface), absolute number of dewy nights and amount of precipitation (in mm).

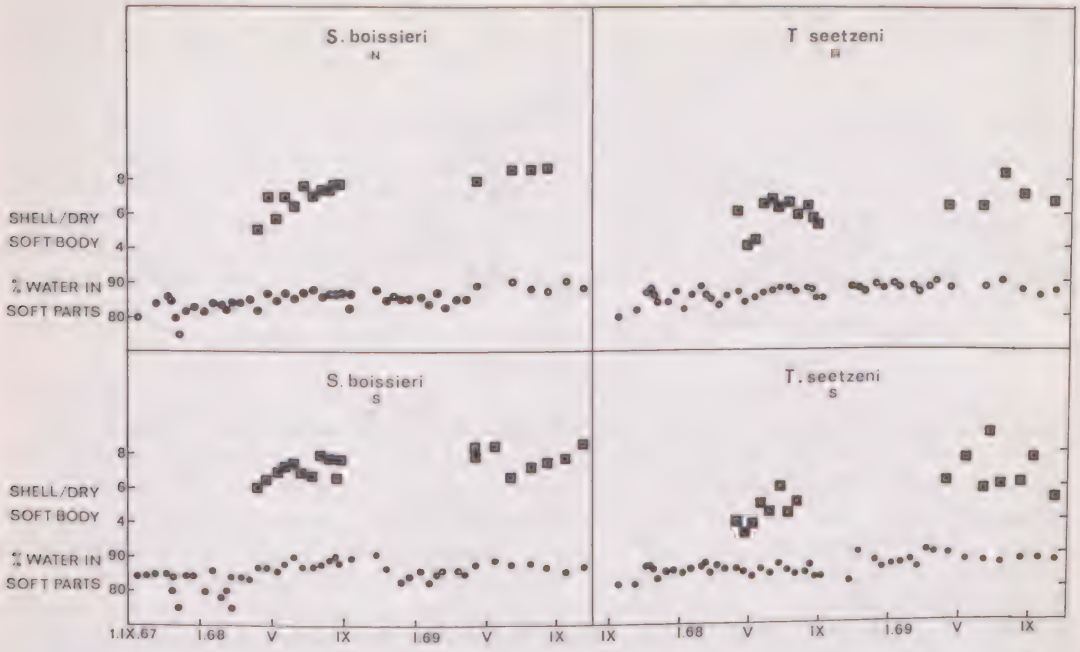


FIG. 1. Water percentage (circles) and shell/dry body ratio (squares) in 2 species of desert snails during the period 1 Sept. 1967–1 Oct. 1969. S = South-facing (southern) slope; N = North-facing (northern) slope.

RESULTS

Fig. 1 shows that the percentage of water in *Sphincterochila boissieri* varies from 75–90.5%. The lowest value was found in November, 1967 when it was approximately 75% in snails occurring on both slopes. In *Trochoidea seetzeni*, the percentage of water varies from 80–90% (the lowest was 80% in September, 1967) among specimens from both slopes. It is also shown that the ratio between dry shell and dry body weight increases in the summer, meaning that the weight of soft-body parts decreases during summer since the weight of the shell does not change in this season.

Certain climatic factors show a high correlation ($p > 0.001$) with water percentage in the body. These factors are temperature and evaporation (Pitche and water surface), which have a negative correlation, and relative humidity, which correlates positively with water percentage in the body. No significant correlation was found with amount of rain and number of dewy nights. Fig. 2 represents the water percentage in the body of snails during the experimental period together with those climatic factors which have a correlation with water percentage.

Difference between the slopes in different seasons

In both winters (November-March 1967/68 and 1968/69) there was no significant difference in water content among snails of the same species on the northern and southern slopes. In both summers there was a significant difference ($p > 0.05$) among *Sphincterochila boissieri* on the 2 slopes and in the 2nd summer also among *Trochoidea seetzeni*. The mean difference between the slopes was 2% in

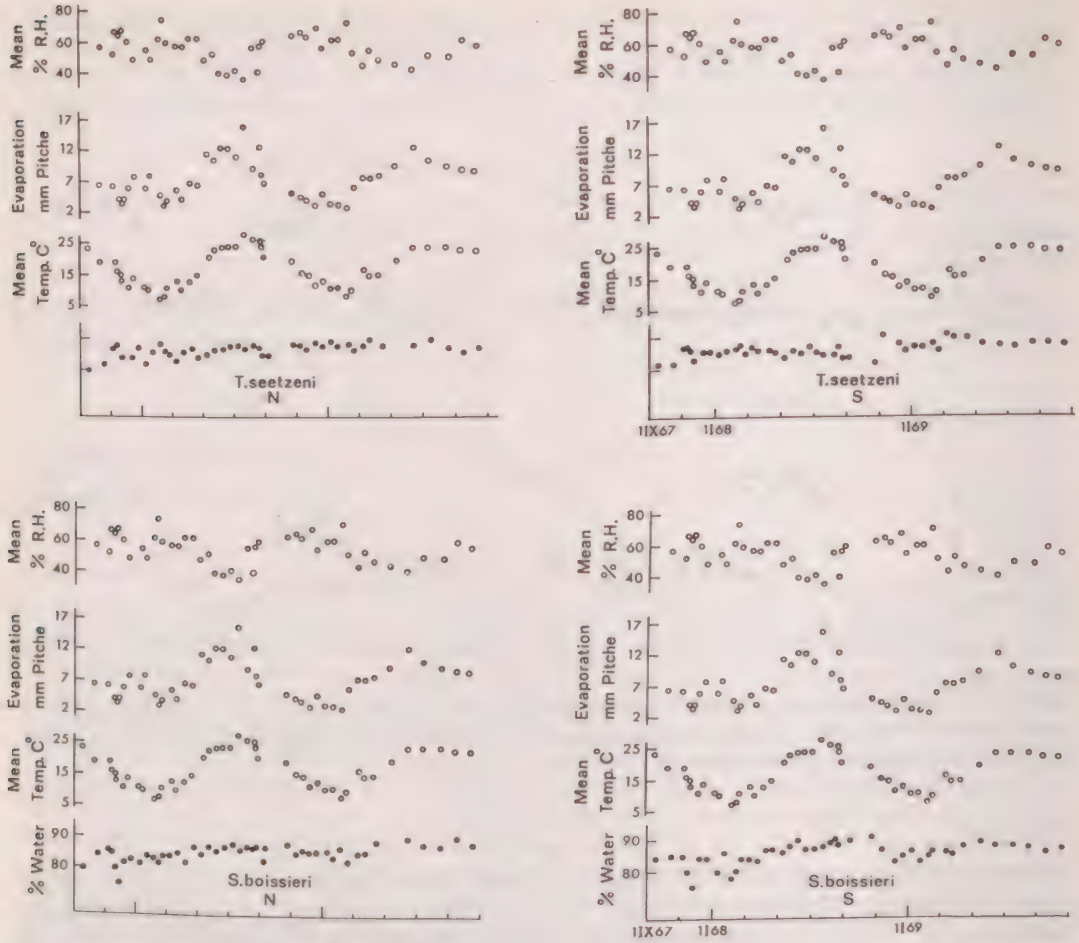


FIG. 2. Water percentage in the body in relation to certain climatic factors (see text for explanation).

all 3 cases. The maximum difference in water percentage between the slopes (in snails that were collected on the same date) was 5.3% in *S. boissieri* and 6.5% in *T. seetzeni*. In most cases the percentage of water was higher on the northern slope.

Difference within the slopes in different seasons

There were significant differences ($p > 0.01$) between the 1st and the 2nd summers (except in *Sphincterochila boissieri* on the southern slope) and between the 1st and 2nd winters. The climate differed greatly, with the annual rainfall being 150 mm in the 1st winter and about 50 mm in the 2nd. A difference in survival rate of these snails during these years is also shown due to influence of the climate (Yom-Tov, in prep.).

The percentage of water in the bodies of *Trochoidea seetzeni* did not change much during the same year. No significant differences were found between the

summer (except in the 1st year on the northern slope) and winter in both years. In *Sphincterochila boissieri* there were significant differences ($p > 0.01$) in percentage of water in the bodies between summer and winter; in the 1st year on both slopes and in the 2nd year only on the northern slope.

Sphincterochila boissieri is more influenced by climatic factors than *Trochoidea seetzeni*. Significant differences in percentage of water in various groups (species/slope/season) were more evident in more groups of *S. boissieri* than *T. seetzeni*. One reason may be that *T. seetzeni* aestivates and feeds on bushes. *S. boissieri* lives and aestivates mostly on the ground. The climatic differences between the slopes are indistinct if not measured on the ground, due to the influence of the wind. *S. boissieri* may therefore be a better indicator of climatic differences between the slopes.

DISCUSSION

The results presented here show that in both species of snails examined there are annual fluctuations of about 10% in fresh body weight. These fluctuations are due to the effect of some climatic factors to which the snails respond. These factors are temperature, relative humidity and evaporation. Since the percentage of water in the body of these snails during summer is relatively stable, in spite of the fact that snails lose a certain amount of water during this period a question arises as to how the snails maintain this stable level. Schmidt-Nielsen (pers. comm.), who measured water loss of these snails in the field during summer, found that they lose about 0.5 mg of their weight every day. This means that during 3 months of aestivation a snail may lose about 50 mg of its soft-body weight. The results of the present work show that the weight of their soft-body parts decreases during the summer, while the percentage of water in the body does not change much. In the light of these facts it may be suggested that the snails decrease their food storage to improve their water balance. This suggestion is supported by the works of Fischer (1950) and Thiele (1959), who stated that glycogen is the main food store of snails and decreases during aestivation or hibernation. Assuming that *Trochoidea seetzeni* and *Sphincterochila boissieri* also use carbohydrates as their main food store, they can gain 50 mg of water by burning 83 mg of glucose, which represents 8.3% of the initial body weight of *T. seetzeni* and about 3.6% of *S. boissieri*. If the actual amount of glycogen in these snails is about the same as in *Helix pomatia* (13.2% of body weight at the beginning of aestivation (Thiele, 1959)) then *T. seetzeni* might aestivate in summer conditions about 158 days and *S. boissieri* about 360 days before death by dehydration. According to this speculation, *S. boissieri* are much more suited to desert conditions than *T. seetzeni*, which is a smaller species.

Another question which arises is do the fluctuations in water content induce snails to enter aestivation. Fluctuations in water content of *Helix pomatia* and Limacidae species were described by Howes & Wells (1934a,b). These authors believed that decrease in water content in the body causes snails to enter aestivation, but the decrease in water content is not dependent on external factors. Wells (1944) showed that fluctuations in body weight occur also when the snails are active and concluded that decrease in body weight does not make the snails enter aestivation. The water content of both species examined in this study does not decrease or increase before entering aestivation in the summer. Thus, fluctuations in water content are not a causal factor for the onset of aestivation.

ACKNOWLEDGEMENTS

I would like to thank Prof. H. Mendelssohn under whose supervision this study was carried out and Mr. J. H. Hoofien for his criticism and valuable comments. Thanks are also due to Mr. A. Perlson, Mrs. N. Shamir, Mr. A. Shub, Mr. R. Kalef, Mrs. M. Rubin and Mrs. R. Manneberg, who helped me in various ways.

LITERATURE CITED

ASHBEL, D. 1952. *Israel climate*. Dept. Meteorol., Hebrew Univ., Jerusalem. [in Hebrew] 244 p.

ASHBEL, D., 1966. Israel climate, *In: Encyclopedia Hebraica*, 6: 159-178. [in Hebrew].

ASHBEL, D., EVIATAR, A., DORON, A. & GANOR, A. 1965. *Solar radiation at various latitudes*. Hebrew Univ., Jerusalem. p 159-178.

FISCHER, M. P. H. 1950. *Vie et moeures des Mollusques*. Payot, Paris. 312 p.

FRIEDMAN, J. 1969. *The role of competition in desert plant associations*. Ph. D. Thesis, Hebrew Univ., Jerusalem. [in Hebrew with English summary]. 115 p.

HOWES, N. A. & WELLS, G. P. 1934a. The water relations of snails and slugs. I. Weight rhythms in *Helix pomatia* L. *J. exp. Biol.*, 11: 327-343.

HOWES, N. A. & WELLS, G. P. 1934b. The water relations of snails and slugs. II. Weight rhythms in *Arion ater* and *Limax flavus* L. *J. exp. Biol.*, 11: 344-351.

KAZENELSON, Y. 1959. The Negev climate. *Teva va'Aretz* [Nature and Country] 1: 301-318. [in Hebrew].

MENDELSSOHN, H. 1963. *Sphincterochila hierochontica* Hora'ath Ha'Teva [Teaching of Nature], 14-15: 25-33. [in Hebrew].

SCHMIDT-NIELSEN, K. 1969. The neglected interface: the biology of water as a liquid-gas system. *Quart. Rev. Biophys.*, 2: 283-304.

SHKOLNIK, A. & BORUT, A. 1969. Temperature and water relations in two species of spiny mice (*Acomys*). *J. Mammal.*, 50: 245-255.

THIELE, O. W. 1959. Die Lipide der Weinbergschnecke (*Helix pomatia*) I. *Z. vergl. Physiol.*, 42: 484-451.

WELLS, G. P. 1944. The water relations of snails and slugs. III. Factors determining activity in *Helix pomatia* L. *J. exp. Biol.*, 20: 79-87.

YOM-TOV, Y. 1970. The effect of predation on population densities of some desert snails *Ecology*, 51(5): 907-911.

YOM-TOV, Y. 1971. Body temperature and light reflectance in two desert snails. *Proc. malacol. Soc. London*, 39(4): 319-326.

YOM-TOV, Y. & GALUN, M. 1971. Note on the feeding habits of two species of desert snails. *Veliger*, 14(1): 86-88.

Y. YOM-TOV

Department of Zoology
Tel-Aviv University
Tel-Aviv, Israel

Malacological Review, 1971, 4: 127-130

MUSSEL FAUNA FOUND IN FORT LOUDOUN RESERVOIR TENNESSEE RIVER, KNOX COUNTY, TENNESSEE, IN DECEMBER, 1970

Billy G. Isom

ABSTRACT

A survey in December 1970 of an 11-mile stretch in the 55-mile-long Fort Loudoun Reservoir on the upper Tennessee River revealed 2 new mussel records for this area: *Anodonta corpulenta* and *A. imbecillis* have extended their range into the post-impoundment shallows of this reservoir. These 2 *Anodonta* species were from habitats similar to those from which they were previously reported in Chickamauga Reservoir in association with *A. suborbiculata* and *Lasmigona complanata*.

Unionidae were restricted essentially to shallow shorelines and sloughs of impoundment origin. Periodic insufficiency of dissolved oxygen (DO) as a result of biochemical oxygen demand (BOD) is probably a principal factor in depletion of native endemic mussel populations in the old river channel in this area.

Ortmann (1918), in his classic study of the mussels (Nayades) of the upper Tennessee River, reported 64 species from the Tennessee River in the general area considered in this paper.

Recent collections from post-impoundment habitats in Fort Loudoun Reservoir, upper Tennessee River, revealed established populations of *Anodonta corpulenta*, *A. imbecillis*, *Proptera alata* and *Corbicula manilensis* (Table 1). Only 1 specimen of *Truncilla truncata* was taken. *P. alata* and *T. truncata* were present prior to impoundment.

Fort Loudoun Dam, which was closed on 2 August, 1943, is located 602.3 miles above the confluence of the Tennessee and Ohio Rivers. The 11-mile area sampled was between Tennessee River Mile (TRM) 624.5 and TRM 635.3, southwest of Knoxville, Knox County, Tennessee. Total length of the reservoir is 55 miles with a drainage area of 9,550 square miles. Ordinary minimum lake level is 807 feet and full pool is 813 feet above sea level. The water level was 807.97 feet above sea level on 2 December, 1970, the date of collection.

Although samples were taken both in the old river channel and in shallower areas, mussel specimens were found only in very shallow water or in areas recently exposed as a result of water level fluctuation. Extensive sampling was conducted on the shoreline in this area. Typical substrate, from which specimens were collected, was, for the most part, soft erosion sediment over hard clay.

Collection sites, species, and representative specimens collected are recorded in Table 1. *Proptera alata* was reported by Ortmann (1918). He reported *Truncilla truncata* below Knoxville in the general area of the present study. Ortmann (1925) indicated that *T. truncata* was present but rare in the upper Tennessee River. He reported complete absence of *Anodonta* in his compilation of the historical fauna of this drainage. However, he did note that there were 2 large specimens of *A. grandis* Say in the Bryant Walker collection from a small pond near the French Broad River, 8 miles above Knoxville.

Ortmann (1925) reported the absence of *Anodonta* in the lower Tennessee River. He noted records of *A. imbecillis* Say and *A. grandis* in some tributaries to the

TABLE 1. Mussels collected from Fort Loudoun Reservoir, Tennessee River, December 2, 1970

Tennessee River Mile (TRM)	Species	No. Specimens Collected
624.5 (right shoreline)	*Anodonta corpulenta* Cooper, 1834	14
	A. imbecillis Say, 1829	3
	Proptera alata (Say, 1817)	9
	Corbicula manilensis Philippi, 1844	7
627.3 (left shoreline, slough)	*A. corpulenta*	8
	P. alata	8
	C. manilensis	3
629.5 (right shoreline, slough)	*A. corpulenta*	14
	P. alata	5
	C. manilensis	3
630.7 (right overbank)	*A. corpulenta*	3
631.1 (margin of island)	*A. corpulenta*	1
	P. alata	1
631.6 (left shoreline, slough)	*A. corpulenta*	15
	A. imbecillis	1
	Truncilla truncata Rafinesque, 1820	1
	P. alata	3
	C. manilensis	2
632.7 (right shoreline, slough)	*A. corpulenta*	6
	A. imbecillis	3
	P. alata	1
	C. manilensis	1
635.3 (right overbank, mud flat)	*A. corpulenta*	5
	P. alata	2
	C. manilensis	12

lower Tennessee River.

Van der Schalie (1939) reported the absence of *Anodonta* in the lower Tennessee River to that date; however, he recorded one specimen of *A. imbecillis* collected at Savannah, Tennessee.

Scruggs (1960) did not report any *Anodonta* from the upper and lower portions of the Tennessee River which he studied.

Bates (1962) was the first to report extensive populations of mussels from post-impoundment habitats in the lower Tennessee River, Kentucky Reservoir, including *Quadrula quadrula, Leptodea* (*Proptera*) *laevissima, L. fragilis, Carunculina par-*

va, Truncilla donaciformis, Anodonta corpulenta, A. imbecillis and *A. suborbiculata*. Isom (1969) first reported *Anodonta* from the upper Tennessee River. Collections from Chickamauga Reservoir included specimens of *A. grandis, A. suborbiculata* and *Lasmigona complanata*. *A. corpulenta* from Fort Loudoun was the typical form often associated with ponds or pond-like environments. *A. imbecillis* was the form most often found elsewhere.

Isom (1969) reported *Anodonta suborbiculata* in Chickamauga Reservoir from a habitat similar to that in Fort Loudoun Reservoir. The 2 reservoirs are separated by Watts Bar Reservoir which is 72 miles long. There are no current data available on mussels in Watts Bar Reservoir. It would be very interesting to know the method of dispersal of *A. suborbiculata* and why it is not found in Fort Loudoun Reservoir.

Post-impoundment habitats have not been studied sufficiently to determine whether populations of *Anodonta* are continuous or discontinuous. The fish host necessary for *A. suborbiculata* dispersal may not be available in Fort Loudoun Reservoir or some factor needed for successful colonization may be absent (Anon., 1961).

In the December, 1970 study, mussels were restricted to areas created as a result of impoundment. This was determined with a 0.9-square-foot Petersen dredge. Nine bottom samples were taken at each of 8 stations--6 in the old river channel and 3 about midway between the old river channel and the floodplain shoreline. The samples revealed a few Asiatic clams but only 1 mussel (*Anodonta corpulenta*).

Hypolimnetic oxygen deficiencies are probably one reason for the lack of mussels in the original river habitats within Fort Loudoun Reservoir. Gianotti (1969) has shown biochemical oxygen demand (BOD) and related oxygen deficiency in the area involved in the present study. Richards (1970) recorded dissolved oxygen (DO) values in Fort Loudoun Reservoir for the period 1966-1968. Based on selected values for May-July, DO content of water near the bottom averaged about 3 mg/l with periodic lows of less than 1 mg/l.

In summary, this study of the Fort Loudoun Reservoir mussel fauna revealed only 4 species of Unionidae and the Asiatic clam (*Corbicula manilensis*) as compared with 64 species of mussels reported by Ortmann (1918). Loss of the native endemic mussel fauna is evidently due to periodic insufficient dissolved oxygen as a result of organic enrichment entering the upper reservoir. *Anodonta* are new records for this portion of the Tennessee River drainage basin. The Fort Loudoun Reservoir habitat is similar to that containing *A. suborbiculata* and *Lasmigona complanata* in Chickamauga Reservoir. These species may eventually become established in Fort Loudoun Reservoir.

LITERATURE CITED

ANONYMOUS. 1961. *Inventory of fish populations, Fort Loudoun Reservoir.* TVA, Div. Forest., Fish., Wildl. Dev., Norris, Tenn. 9 p, Appendix 20 p.

BATES, J. M. 1962. The impact of impoundment on the mussel fauna of Kentucky Reservoir, Tennessee River. *Amer. Midl. Natur.*, 68(1): 232-236.

GIANOTTI, F. B. III. 1969. *A study of self-purification under unsteady flow conditions using dye tracer techniques.* Thesis, Univ. Tenn., 63 p. [Fort Loudoun Reservoir was the study location.]

ISOM, B. G. 1969. The mussel resource of the Tennessee River. *Malacologia*, 7(2-3): 397-425.

ORTMANN, A. E. 1918. The nayades (freshwater mussels) of the upper Tennessee drainage, with notes on synonymy and distribution. *Proc. Amer. phil. Soc.*, 57: 521-626.

ORTMANN, A. E. 1925. The naiad-fauna of the Tennessee River system below Walden Gorge. *Amer. Midl. Natur.*, 9: 321-372, 1 map.

RICHARDS, K. A. 1970. *Statistical methods for determining the dissolved oxygen in Fort Loudoun Reservoir*. Thesis, Univ. Tenn., 69 p.

SCRUGGS, G. D., Jr. 1960. Status of fresh-water mussel stocks in the Tennessee River. *U.S. Fish and Wildl. Serv., Spec. Sci. Rept., Fish.*, No. 370: 1-41.

VAN DER SCHALIE, H. 1939. Additional notes on the Naiades (fresh-water mussels) of the lower Tennessee River. *Amer. Midl. Natur.*, 22(2): 452-457.

B. G. ISOM

Environmental Biology Branch
Division of Environmental Research
and Development
Tennessee Valley Authority
Muscle Shoals, Alabama 35660
U. S. A.

Malacological Review, 1971, 4: 131-202

TAXONOMIC STUDIES OF THE LAND SNAIL FAMILY SUCCINEIDAE [1]

C. M. Patterson

ABSTRACT

The Succineidae, predominant members of the stylommatophoran suborder Heterurethra, is a morphologically diverse pulmonate land snail family of world-wide distribution and apparently great antiquity. It is an important group to examine in attempts to discern evolutionary trends within the order Stylommatophora because its members share some morphological characters in common with the more primitive Basommatophora and Opisthobranchia. The taxonomic placement of most succineid species is still based on shell characters which give only fragmentary aid in systematic analyses of this family. Currently, morphological features of the shell, jaw, radula and anatomy of the reproductive tract are being used to characterize taxa, but few species have been studied in this regard.

The Succineidae are especially interesting cytologically because their known haploid chromosome numbers represent the widest range in any molluscan group and several species of *Catinella* have the lowest haploid chromosome numbers yet reported in the Mollusca.

The unique anatomical and cytological features of the Succineidae and the need for a systematic study of the family on a world-wide basis led to the current study, an investigation into the systematic relationships of some genera and species of Succineidae based on morphological-anatomical and cytotaxonomic studies.

Morphology of the shell, jaw and radula, reproductive anatomy and cytotaxonomy of 8 of the 12 recent genera were considered. Chromosome numbers of 19 species were reported for the first time. As a result of this study, *Indosuccinea*, formerly placed in the subfamily Catinellinae (lacking a penial sheath), is now included in the Succineinae because it possesses a penial sheath. The genera "*Helisiga*" and "*Hyalimax*" morphologically belong in the genus *Succinea*. *Succinea*, formerly divided into 9 subgenera, includes only 2 valid subgenera, *Succinea* s.s. and *Hyalimax*. *Catinella*, currently contains 3 subgenera. However, no evidence was found supporting a separation of the North American *Catinella* (*Mediappendix*) from the European *Quickella*. It is recommended to consider the Pacific *Catinella* s.s. and Euro-American *Quickella* as the only valid subgenera of *Catinella*. *Quickia*, which formerly contained 1 species, now includes at least 6 species and 2 subgenera (*Quickia* s.s. and *Burchella*).

Succinea is found on every continent; *Oxyloma* occurs in the Americas, Europe, Asia and Africa. *Omalonyx* occurs in the Caribbean region and in central and South America. *Catinella* inhabits a few European areas, North America and various Pacific islands. *Quickia* is an Afro-Indian genus. The

---

[1] From Ph. D. thesis submitted to the University of Michigan, May, 1970. This investigation was supported (in part) by PHS Training Grant No. 5 T1 AI 41 from the National Institute of Allergy and Infectious Diseases, U.S. Public Health Service, Washington, D.C., (in part) by grant GB-5601 from the National Science Foundation, Washington, D.C., and (in part) by grant GB-8212 from the National Science Foundation to the Museum of Zoology, University of Michigan, for research in systematic and evolutionary biology.

other genera are more restricted in distribution with some being highly endemic (i.e., *Lithotis, Camptonyx, Succinoides*).

Haploid chromosome numbers range from n=5-25 among the 44 species studied. There is some evidence for conservatism at the generic or subgeneric taxonomic levels with regard to chromosome number change (i.e., n=25 in all *Quickia*; 2 *Catinella* s.s. have n=5, but *Quickella* species have n=6; all *Neoxyloma* have 19 pairs of chromosomes). There is an indication that cytotaxonomic information may aid in assessing systematic affinities of various succineids.

The mean haploid chromosome number for the Heterurethra is 17.1, which is 8 bivalents less than the mean for any of the other 3 stylommatophoran suborders. If the previous suggestions that lower chromosome numbers are generally found in more "primitive" groups is true, then cytotaxonomic data seems to support the view, based on morphology, that the Succineidae is the most primitive land snail group.

CONTENTS

INTRODUCTION	133
MATERIALS AND METHODS	134
RESULTS	136
Morphological-anatomical studies	136
Succinea putris	137
Succinea kuntziana	139
Hyalimax maillardi	142
Oxyloma cleopatrae	145
Omalonyx felina	147
Neosuccinea kofui	151
Indosuccinea khandalla	153
Lithotis rupicola	155
Catinella putamen	157
Catinella vermeta	159
Quickia spurca	163
Quickia bensoni	165
Quickia calcuttensis	167
Cytotaxonomic studies	169
DISCUSSION	175
Phylogenetic position of the Succineidae	175
Zoogeography	180
Morphological and anatomical features	182
Key to the valid genera and subgenera of Succineidae	193
Major anatomical characters of subfamilies and genera studied	194
Classification of recent Succineidae	195
Cytotaxonomy	196
SUMMARY AND CONCLUSIONS	198
ACKNOWLEDGEMENTS	200
LITERATURE CITED	200

TABLES

1. Haploid chromosome numbers in the family Succineidae	171
2. Haploid chromosome numbers of the Stylommatophora	197

ILLUSTRATIONS

Morphological-anatomical illustrations

1-10.	*Succinea putris*	138
11-21.	*Succinea kuntziana*	141
22-29.	*Hyalimax maillardi*	143
30-37.	*Oxyloma cleopatrae*	146
38-46.	*Omalonyx felina*	148
47-59.	*Neosuccinea kofui*	150
60-68.	*Indosuccinea khandalla*	152
69-80.	*Lithotis rupicola*	156
81-88.	*Catinella putamen*	158
89-97.	*Catinella vermeta*	160
98-105.	*Quickia spurca*	162
106-112.	*Quickia bensoni*	164
113-120.	*Quickia calcuttensis*	166

Meiotic chromosomes

121-131	173
132-140	174

INTRODUCTION

The majority of land snails, including the Succineidae, belong to the Stylommatopha, which is generally considered to be the most phylogenetically advanced order in the gastropod subclass Euthyneura (=Pulmonata + Opisthobranchia). The Stylommatophora are divided into 4 suborders (Heterurethra, Orthurethra, Mesurethra, Sigmurethra), based on the position of the ureter relative to that of the kidney, heart and anus. The Succineidae, predominant members of the suborder Heterurethra, is a family of morphologically diverse pulmonate land snails of worldwide distribution and apparently great antiquity. The taxonomic placement of most species of the Succineidae is still based largely on shell characters, which, because of little diversity and considerable convergence, give only fragmentary or unreliable aid in systematic analyses. Currently, features of the male and female reproductive tracts, the radula and jaw, and to some extent, patterns of pigmentation, are being used to characterize some genera and species. However, to date, only a very few species have been studied with regard to such morphological characters, which leaves the systematics of the Succineidae in an inadequate and confused state.

The family Succineidae is rather special among land snails since its members share a number of morphological characters in common with more primitive groups such as the Basommatophora and Opisthobranchia. Because they possess these characters, Cook (1966) and Van Mol (1967) considered the Succineidae to be the most primitive land pulmonate snail group. Thus, succineids are an important group to examine in many details in an attempt to discern the evolution-

ary trends within the Stylommatophora.

The Succineidae is especially interesting cytologically because haploid chromosome numbers of its members represent the widest variation in any molluscan group (Patterson, 1969) and because the lowest haploid numbers known in the Mollusca occur in several species of the genus *Catinella* (Burch, 1964a, b; Patterson & Burch, 1966; Patterson, 1969).

The unique anatomical and cytological features of the Succineidae and the need for a systematic study of the family on a worldwide basis led to the initiation of the current study, an investigation into the systematic relationships of the genera and species of Succineidae employing techniques of cytology in conjunction with classical anatomy and morphology.

MATERIALS AND METHODS

Shell, jaw and radular morphology

Shells were cleansed using a soft camel hair brush and warm water. The periostracum of some shells was removed by sodium hypochlorite (commercial "Clorox") in order to more clearly observe microsculpture.

The buccal mass was dissected from the snail's head region, and from this the jaw and radula were carefully removed. The tissues remaining on the jaws and radulae were removed using fine watchmaker's forceps or by the chemical action of 10% potassium hydroxide solution. The jaws were then placed in 70% ethanol for observation. The shell and jaw were observed using a Wild M5 stereoscopic dissecting microscope; illustrations were prepared with the aid of a camera lucida.

The radula was placed on a glass slide, dorsal side up, flattened and mounted temporarily in 70% ethanol. A coverslip was applied and sealed to the slide with gum mastic and paraffin. Observations of radulae were made using a compound microscope having 10X oculars and 40X high-dry and 100X oil immersion objectives.

External morphology and anatomy of the reproductive tract

Both field collected and laboratory reared adult snails were used for morphological-anatomical studies. These were relaxed in tap water to which a few crystals of menthol had been added. When the animals were fully extended and gave no reaction to tactile stimulation (usually after 14-16 hours), they were killed and fixed in a solution of alcohol-formalin-acetic acid.[2] After 15 minutes, the snails were rinsed and preserved in 70% ethanol. Petri dishes half filled with blackened, solidified paraffin served as the dissecting vessels. Tips of # 00 stainless steel insect pins were used when needed to hold the soft parts in position. Observations were made using a Wild M5 microscope. Illustrations were made with the aid of a camera lucida attachment.

In a few cases, features observed during dissections were verified from tissues prepared by the usual paraffin section technique. Such tissues were cut in 10 micra thick sections and stained with Mallory's aniline blue staining method.

Laboratory snail culture

Field collected specimens (usually adults or young adults) were maintained in the laboratory in 200 mm X 60 mm glass preparation dishes containing 3/4 inch sterilized sand. This sand was covered with a 3-4 mm thick layer of a clay-sand mixture (about 1:15 parts by volume) which was sprinkled with a small amount of calcium carbonate and chopped cereal grasses (commercial Cerophyl or Cerolife). Lettuce sprinkled sparingly with calcium carbonate and chopped cereal grasses served as the food source. Each culture chamber, covered with perforated plastic wrap secured with a rubber band, contained about 30 individuals. Daily cleansing and a fresh food and water supply was necessary for each container. Only spring water was used. Eggs were removed daily from the adult's containers and placed on wet sand in 40 mm Petri dishes covered with plastic wrap. Young hatched within 7-9 days and were transferred to the large containers. Chopped cereal grasses were the only food given very young individuals. As many as 100 newly hatched young could be placed in these dishes, but they were removed to containers having no more than 30 snails when they reached 1.5-2 mm in length. The temperature within all culture chambers was maintained at 28-30°C by placing them on a thermostatically controlled electric blanket covered with heavy duty plastic. Only 4-6 weeks was required to grow 1 generation of most species.

Cytology

Animals were fixed for cytological studies in either Newcomer's (1953) fluid or a mixture of 95% ethanol

[2]Composed of 50 ml distilled water, 40 ml 95% ethanol, 10 ml formalin and 2 ml glacial acetic acid.

and glacial acetic acid (3:1 parts by volume). Ovotestes were dissected from the fixed animals and chromosome preparations of these were made using the acetic-orcein squash technique (La Cour, 1941). Chromosomes were observed using a Leitz compound stereoscopic microscope with 10X or 15X oculars, 90X (n.a. 1.32) light field and 100X (n.a. 1.30) phase contrast oil immersion objectives. Drawings were made with the aid of a camera lucida attachment.

Snails studied

Succinea campestris. Collected from vegetation growing on sand dunes near the beach, Sapelo Island, Georgia, U.S.A. by the author, 4-6-68.

Succinea concordialis. Collected along railroad track, Blakely I., Mobile Co., Alabama, U.S.A. by Mr. Leslie Hubricht, 4-6-68 and from the shore of Lake Concordia, Concordia Co., Louisiana, U.S.A. by the author 4-4-68.

Succinea grosvenori. Collected along roadside near Silax, Choctaw Co., Alabama, U.S.A. by Mr. Leslie Hubricht, 4-7-68.

Succinea kuntziana. Collected on Éfate I., New Hebrides by Dr. J. B. Burch, January, 1967.

Succinea lauta. Collected at Sakuyama, Otawara City, Tochigi Pref., Honshu I., Japan in October, 1968. Obtained by Dr. T. Habe.

Succinea luteola. Collected near Mississippi Port, Gulfport, Harrison Co., Mississippi, U.S.A. by Mr. Leslie Hubricht, 5-11-68.

Succinea ovalis. Collected at Comstock Park, Comstock, Kalamazoo Co., Michigan, U.S.A. by the author in June, 1968 and July, 1969.

Succinea putris. Collected from the banks of the Oise River, Auvers-sur-Oise, France by Mrs. Sharon McDonald, June, 1967 and from the banks of the Marne River near Chelles, France by Dr. J. Gaillard, October 1968.

Succinea strubelli. Collected near Popendetta, Papua by Dr. J. B. Burch, October, 1966.

Succinea urbana. Collected along roadside near Geiger, Sumter Co., Alabama, U.S.A. by Mr. Leslie Hubricht, March, 1968.

Succinea sp. Collected near Rincon Drain, Dõna Ana Co., New Mexico, U.S.A. by Dr. Artie Metcalf, February, 1968.

Succinea sp. Collected 5 miles E. of Canutillo, El Paso Co., Texas, U.S.A. by Dr. Artie Metcalf, March 1968.

"Helisiga" sanctaehelenae. St. Helena Island. From collections of the British Museum of Natural History; sent to me by Mr. J. Peake.

Hyalimax maillardi. Réunion Island. From the collections of the British Museum of Natural History; sent to me by Mr. J. Peake.

Oxyloma cleopatrae. Collected from drain at the airport, Alexandria, Egypt by Dr. B. C. Dazo, May, 1965.

Oxyloma retusa. Collected from a marsh near Ann Arbor, Washtenaw Co., Michigan, U.S.A. by the author, June, 1968 and July, 1969.

Oxyloma salleana. Collected at the edge of the Mississippi River, Southport, Jefferson Co., Louisiana, U.S.A. by the author, March, 1968.

Omalonyx felina. Antigua, B.W.K. Sent by Dr. D. S. Dundee, October, 1967.

Neosuccinea kofui. Collected near Imasuwa, Shirane-machi, Nakakomagun, Yamanashi Pref., Honshu I., Japan by Dr. J. B. Burch, February, 1968.

Indosuccinea khandalla. Collected from the leaves of mango trees near Khandalla, Bombay Pres., India by the author in July, 1969.

Lithotis rupicola. Collected from rocks of seepage area near Khandalla, Bombay Pres., India by Dr. J. B. Burch in July, 1969.

Catinella putamen. Collected from Malololelei and Laloanea, Upolu I., Samoa by Dr. Yoshio Kondo, 1967.

Catinella rotundata. Collected from plants on Palikea, Wainae Range, Oahu I., Hawaii, U.S.A. by Dr. Henry van der Schalie, April, 1968.

Catinella aprica. Collected near roadside, Scooba, Kemper Co., Mississippi, U.S.A. by Mr. Leslie Hubricht, March, 1968.

Catinella texana. Collected at roadside near Geiger, Sumter Co., Alabama, U.S.A. by Mr. Leslie Hubricht, March, 1968.

Catinella vermeta. Collected at Comstock Park, Comstock, Kalamazoo Co., Michigan, U.S.A. by the author, June, 1968 and July, 1969.

Catinella sp. Collected near pond, 11 miles N. Cananea Junction, Sonora, Mexico by Mr. Richard Russell, February, 1968.

Catinella sp. Collected from swampy area at Cienega, Hidalgo Co., New Mexico, U.S.A. by Mr. Richard Russell, May, 1968.

Quickia spurca. Collected from the grounds of the Liberian Institute for Tropical Medicine, Harbel, Liberia by Dr. Wm. Sodeman, October, 1968 and November, 1968.

Quickia bensoni. Collected from the wall of an empty moat, Fort William, Calcutta, India by the author July, 1969.

Quickia calcuttensis. Collected from the edge of Ballygunge Lake, Calcutta, India by the author in July, 1969.

Quickia cf. *gravelyi*. Collected on mud bank of Periyar River, Madras State, India by the author, January, 1968.

Quickia sp. South I., Aldabra Atoll. Sent by Dr. C. A. Wright, January, 1968.

RESULTS

MORPHOLOGICAL-ANATOMICAL STUDIES

The shell is the most prominent and preservable morphological structure of most gastropod mollusks, and for this reason the shell historically has been used as the basis for species recognition and classification. Even today, the taxonomy of many gastropod groups is based mainly on characters of the shell. However, the shells of Succineidae generally lack the diversity of characters needed for identification and classification, and therefore, shell features can only be employed as specific characters in those taxa where sufficient diversity is evident among the species under consideration. For example, among the shells I have examined, the genera *Catinella*, *Quickia*, *Succinea*, *Oxyloma*, *Litholis*, *Neosuccinea* and *Indosuccinea* all contain some representatives with shells very similar to those of species in 1 or more other genera. On the other hand, the shells seem to be generically distinct in *Omalonyx*, *Camptonyx* and *Boninosuccinea*. These latter genera contain only a few species.

The jaw of all succineids is composed of a cutting piece attached to a basal accessory plate or flange. For the most part, there is little jaw variability between taxa, but where differences do occur, although subtle, they usually seem to be species specific.

The radular teeth have a relatively simple structure which is basically the same in all members of the Succineidae. The central tooth is quadrate and tricuspid; the lateral teeth are also quadrate, but either bicuspid or tricuspid; and the marginal teeth are variable in shape and number of cusps present. Among species of a single genus, and even within most populations of a single species, there is usually considerable variability, including the total number of teeth in a row. The number of rows of radular teeth also varies. The radula does not possess characters useful in delineating genera but may, in some cases, possess taxonomically useful species specific features.

Quick (1933, 1934, 1936, 1939a, b, c) published the fundamental anatomical studies which have led to a reasonably satisfactory classification of the Succineidae. His system was based primarily on features of the reproductive tract, and he pointed out the importance of characters of the terminal male genitalia in grouping species. However, he left the anatomical recognition of genera to some of his successors (Pilsbry, 1948; Odhner, 1950). Some other anatomical studies include those of Cooke (1921), Rao (1924, 1925), Boettger (1939), Matekin (1950), Habe (1956), Franzen (1959, 1963, 1964, 1966, 1969), Rigby (1965), Cook (1966), Hudec (1966) and Van Mol (1967). Since most of the species already studied with regard to reproductive anatomy are representatives from North America and Europe (including Britain), I have mainly studied forms from other parts of the world, and especially the Afro-Indian genus *Quickia*.

To summarize, with regard to morphology, the features of the shell, jaw and radula are most useful as species specific characters; anatomical features of the reproductive tract, and in some cases the body form, are the only valid criteria upon which to base generic diagnoses among members of the Succineidae.

A series of detailed morphological-anatomical descriptions of members belonging to 8 of the 12 recent genera of Succineidae follows. It is hoped that the information presented in these studies will aid in the diagnoses of the genera and serve as a model for the study of and a basis for comparison of other members of the Succineidae.

GENUS *SUCCINEA* Draparnaud
SUBGENUS *SUCCINEA* S.S.
Succinea putris (Linneaus)

Shell

Specimens used in this study were collected by Mrs. S. McDonald from the banks of the Oise River, Auvers-sur-Oise, France, in June, 1967 and by Dr. J. Gaillard from the banks of the Marne River, near Chelles, October, 1968. The shell of *Succinea putris* has a dull horn color, is moderately strong and varies in shape from ovate to ovate-attenuate. One of the larger shells has 3 1/2 whorls, measures 20 mm in length, 12 mm in width and has an oval aperture which is 14 mm long. This specimen is more ovate in shape. Another specimen (Fig. 1) is more attenuate and measures 17 mm in length, 10 mm in width and has an apertural length of 11 mm. The spire is short in all specimens. A columellar plait is present and there is a slight thickening of the columellar edge (although not a columellar fold). The shell is sculptured with many fine growth lines. The whorls are rounded with slightly depressed upper peripheral margins. The sutures are moderately impressed. Quick (1933) gave a similar description for British shell specimens of *S. putris*. He illustrated variation in shell shape from globose to more elongate (Quick, 1934, fig. 6).

Jaw

The jaw of *Succinea putris* is shown in Fig. 2. It is very strongly chitinized, amber-brown in color with dark brown areas on the cutting piece and basal accessory plate. The arms of the cutting piece are rounded on the outer peripheral margins while the posterior margin has a concavity near the middle. The convex anterior margin of the cutting piece is irregular with 2 folds on each side of a median prominence. The sides and posterior margin of the basal accessory plate are straight. This description basically agrees with that given by Quick (1933, 1934) for the British specimens with the exception of 2 points: (1) the anterior margin is more convex in the British specimens (Quick, 1933, pl. 24, fig. G, H) and (2) the darker fan-like pattern on the basal plate of British specimens is not present on the jaw of the French specimens, which have instead a small V-shaped dark area on each side of the basal plate (Fig. 2).

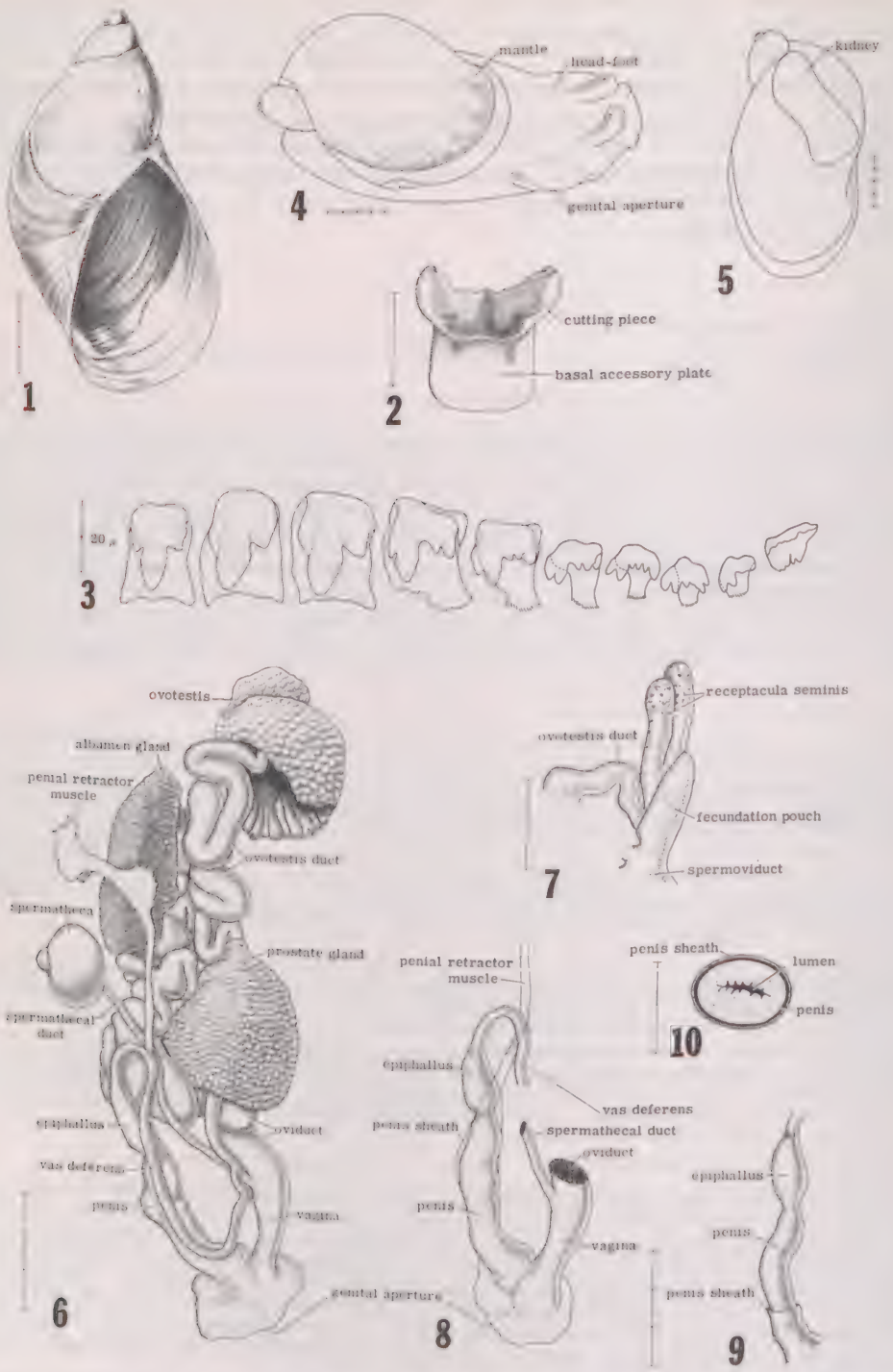
Radula

The radular formula for the Marne River population of *Succinea putris* is 21: 12: 1: 12: 21 There is a small amount of variation in the number of marginal teeth, but there are never more than 23. Lateral teeth vary from 12 to 13. Fig. 3 shows some representative teeth of *S. putris* used in this study. Quick (1933) reported the lateral teeth of British *S. putris* to vary from 10 to 14 and marginal teeth numbered from 22 to 27. Generally, the radulae of French specimens resembles those of the British populations. However, I could not observe the finely irregular posterior margin of the base of the central and lateral teeth reported for British specimens. Such irregularities were clearly seen on the base of the marginal teeth.

Anatomy

The body of living and alcohol preserved specimens of *Succinea putris* is a translucent yellowish-white color. The head-foot of many secimens is almost completely devoid of pigmentation. Other specimens have a small amount of gray color on the head-foot. A specimen with the maximum amount of mantle and head-foot pigmentation is shown in Fig. 4. The peripheral portion of the mantle is quite black while the remainder has less black pigmentation giving it a dark gray appearance. A small amount of black pigmentation is present on the penultimate whorl of the animal. The connective tissue covering the dorsal tentacle is solid black and is easily seen through the body wall. The foot of 1 of the large individuals is 25 mm long, 10 mm wide and is distinctly tripartite. The kidney is large, creamy-yellow in color and has the shape shown in outline on Fig. 5.

Fig. 6 shows a ventral view of the reproductive tract of *Succinea putris*. The ovotestis is ample in size and occupies most of the spire region. It is coiled in 2 1/2 turns. It is composed of many acini of somewhat varying sizes with the largest ones present on the dorsal side of the gland. The ovotestis has a



FIGS. 1–10. *Succinea putris*. 1, Shell; 2, Jaw; 3, Radular teeth; 4, Body pigmentation; 5, Kidney shape; 6, Ventral view of the reproductive tract; 7, Receptacula complex; 8, Terminal male and female genitalia; 9, Terminal male genitalia; 10, Cross-section of the penis. Scale lines in mm.

creamy beige color and is pigmented with a scattered amount of black granules. The ovotestis duct emerges from the ovotestis as a small passage which soon becomes greatly enlarged as the seminal vesicle. The seminal vesicle portion of the duct is folded and convoluted. The duct again becomes small as it empties into the upper spermoviduct. The ovotestis duct is also creamy beige in color and has scattered black pigment along its length which gives it a gray overtone. There are 2 receptacula seminis of unequal length (Fig. 7). They are white in color and have a small amount of black pigmentation on the outer connective tissue covering of the apical region of the tubes. The fecundation pouch is of moderate size, white in color and surrounds the base of the receptacula seminis and ovotestis duct (Fig. 7). The albumen gland is of moderate size and has a creamy, off-white color. It is composed of many very small tubules and has a linguiform shape. The ducts of the ovotestis, receptacula seminis, fecundation pouch, albumen gland and vas efferens are all found in the region of the uppermost portion of the spermoviduct. The prostate gland is white in color and is shaped somewhat like a strawberry. It is composed of many tubules which are slightly smaller than the ovotestis acini. The secretory products of the prostate gland pass through a single duct to the vas deferens which passes on the dorsal side of the prostate. The spermoviduct and posterior portion of the oviduct are white in color with a slight translucency. They are compactly folded along their length. The upper-most portion of the spermoviduct has a distinctly glandular appearance. The uteral portion of the oviduct becomes a solid white color. The walls of the oviduct anterior to the uterus are thick and muscular in appearance. The oviduct is sometimes pigmented with a dull orange color along its anterior-most horizontal portion. The spermatheca has an oblong-spheroid shape and is relatively small. Its duct is long and narrow and joins the inner side of the oviduct at a point approximately half the distance from the genital aperture and the apex of the first bend of the oviduct. The vagina is moderately long, thick-walled and has a muscular appearance. It is furnished with internal folds of tissue which project into the lumen. The penis is a tube approximately twice the length of the vagina. It has a white color and muscular appearance. It is thick-walled with small longitudinal inner folds of tissue which project into the lumen (Fig. 10). The penis constricts abruptly at its posterior end at the junction with the short epiphallus (Fig. 9). The epiphallus does not appear to have inner folds but does have an extremely muscular wall. The epiphallus narrows at the junction with the vas deferens. The vas deferens makes a bend and courses anteriorly to the base of the penis, bends posteriorly and passes along the inner ventral side of the oviduct to the dorsal side of the prostate gland. The vas deferens has a muscular wall with a small number of external black pigment granules on the portion passing along the penis of some specimens. There is a well developed penial sheath which is relatively thin and quite closely appressed to the penis near the base (Fig. 10). It becomes thinner and nearly transparent near the posterior end of the penis. The penial sheath encloses a small portion of the epiphallus, passes around the vas deferens and attaches directly to the penial retractor muscle (Fig. 8). The penial sheath cannot be separated, as in some other *Succinea*, by dissection into 2 layers of mucular tissue. Serial paraffin sections reveal inner longitudinal and outer circular muscle layers. Rigby (1965) reported the same condition. The penial retractor muscle attaches firmly at the junction of the narrow portion of the epiphallus and the vas deferens. It inserts mainly in the mantle wall just anterior to the second intestinal loop on the left side, while another branch attaches in the supporting tissue just posterior to the left end of the kidney. The penis and vagina lead separately into the genital atrium. There is no anterior common reproductive channel, *per se*. The body wall around the region of the crescent-shaped genital aperture is often expanded (Fig. 4) in preserved specimens.

Quick (1933) summarized the work of various authors who had studied some aspects of the anatomy of *Succinea putris*. He also gave his own account of its reproductive anatomy. The conditions observed in these specimens basically agrees with Quick's (1933) report. However, this account mentions many points not discussed by Quick and the size proportions of several reproductive structures are different.

Rigby (1965) presented a valuable account of the functional morphology of the reproductive tract of *Succinea putris*. Her observations of the reproductive anatomy of *S. putris* are similar to those presented here with only 1 major exception: Rigby stated that "...the stalk of the bursa copulatrix [=spermathecal duct] connects with the anterior part of the vagina near the junction with the atrium." The observations from this study and those of Quick (1933) show the spermathecal duct joining with the oviduct some distance (2-2.5 mm) posterior to the atrium. The vagina is the portion of the duct anterior to this junction.

Succinea kuntziana Solem

Shell

Specimens of *Succinea kuntziana* were collected by Dr. J. B. Burch on the northwest corner of Éfate Island, New Hebrides, in January, 1967. They were found in the debris around and on the base of coconut trees. The shell of *S. kuntziana* (Fig. 11) has 2 1/2 to 3 whorls and the larger specimens measure 9 mm in length, 5.5 mm in width with an apertural length of 7.5 mm. The shell is a light orange-tinted horn color, very glossy inside and moderately shiny on the exterior surface. The shell is ovate-attenuate in shape with a relatively short spire. There is a columellar plait but no columellar fold. The aperture is oval. The whorls are rounded with slightly depressed upper peripheral margins especially between the body and penultimate whorls. The sutures are well impressed. Growth lines provide the only sculptural

features of the shell. The spire region of most specimens was covered with encrusted debris. The spire has a reddish tinge.

Solem (1959) described *Succinea kuntziana* as a new species. In his description of the shell he did not mention the depression on the upper peripheral margin of the whorls, the well impressed sutures, the presence of a columellar plait and absence of a columellar fold. These features add to the description of the shell of *S. kuntziana*. An examination of the paratype specimens in the UMMZ collection show the same features mentioned for the specimens used in this study.

Jaw

The jaw (Fig. 12) of *Succinea kuntziana* is amber in color with a light brown area on the cutting piece. The basal accessory plate is nearly uniform in color. The jaw is small but quite strongly chitinized. The arms of the cutting piece are rounded and the posterior margin is straight. The anterior margin of the cutting piece is convex with a distinct median prominence. The basal accessory plate is nearly square. The width of the jaw is slightly greater than the height when measured at the greatest dimensions.

Solem (1959) gave the following brief description of the jaw of *Succinea kuntziana*: "Jaw without accessory ribs and having only a small median projection". It should be noted that the median prominence [=projection] is not relatively smaller than that often present on the jaw of many other succineid species.

Radula

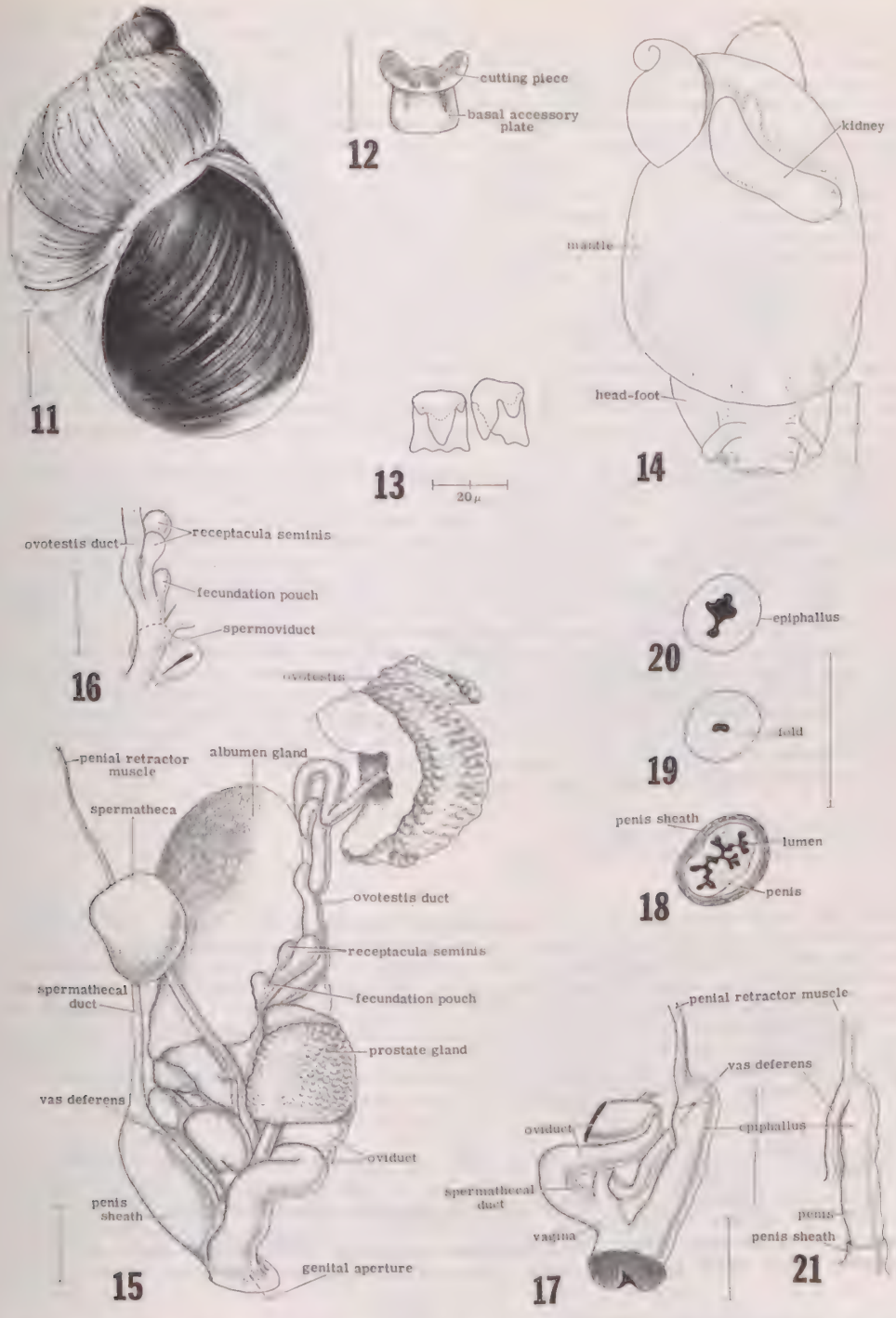
The radular formula for specimens used in this study is 22-23:8-9:1:8-9:22-23. The amount of variation was not great among members of this population. The large cusp of the central tooth exceeds 85% of the length of the base (Fig. 13) in unworn teeth. The posterior margin of the base is irregular.

A radular formula of 13-20:7-9:1:7-9:13-20 was reported by Solem (1959) for *Succinea kuntziana*. He stated that the mesocone [=large cusp] of the central was "...slightly less than two-thirds the length of the basal plate". However, his illustration of the central tooth shows the mesocone to exceed 70% of the length of the basal plate. The radula of the population from Éfate Island has more marginal teeth than the specimens studied by Solem.

Anatomy

The body of living specimens of *Succinea kuntziana* is colored with an orange tinge (Dr. J. B. Burch, pers. comm.). This coloration is almost completely lost in the head-foot region in the alcohol preserved specimens which have a beige-white colored head-foot. The foot of a relaxed specimen measures 11.5 mm in length, 4 mm in width and is tripartite. The head-foot region is lightly pigmented with black spots and small patches. The pattern of black mantle pigmentation is shown in Fig. 14. Most distinctive are the elongate dark black patches at the mantle margin. These are readily seen through the shell. There is also a prominent black area just posterior to the kidney. The kidney of preserved specimens is beige in color and has the shape shown in outline on Fig. 14.

Fig. 15 shows a ventral view of the reproductive tract of *Succinea kuntziana*. The ovotestis is relatively large and occupies most of the spire region. It is beige with an orange tinge of color and composed of many rather large acini. There is a sparse amount of black pigment on the dorsal apical portion of the gland. The ovotestis duct emerges as a thin passage which soon enlarges to form the seminal vesicle portion of the duct. The distended seminal vesicle is folded several times along its length, has a glossy appearance, a slightly lighter color than the ovotestis and a few black pigment granules on the connective tissue covering the duct. Some specimens have more dense pigmentation on the seminal vesicle. The ovotestis duct narrows again just as it leads into the region of the upper spermoviduct. There are 2 receptacula seminis of unequal length which have the same light beige-orange color as the ovotestis duct. They have a small amount of black pigmentation on their outer connective tissue covering. There is some variation in the length of the 2 receptacula seminis. In some individuals they are greatly subequal in length (Fig. 16), while in others they are moderately subequal in length (Fig. 15). There is a distinct fecundation pouch which resembles the shape of the receptacula seminis. Furthermore, the fecundation pouch is not closely appressed to the side of the receptacula seminis as in all other succineids I have examined. It also has a tiny amount of black pigmentation which is a rather unique feature of this species. The ducts of the ovotestis, receptacula seminis, fecundation pouch, albumen gland and vas efferens all lead into (or from) the region of the upper spermoviduct. The albumen gland is very large and colored a creamy orange. The elongate linguiform gland is composed of many tiny tubules. The spermoviduct and posterior oviduct have a white color and slightly glandular appearance. Both are compactly folded along their length. The uteral portion of the oviduct has slightly thicker walls and internal folds of tissue are visible externally. At the point of the last bend anteriorly, the oviduct becomes very thick-walled and muscular in appearance. The spermatheca has a light beige-orange color and is irregularly spheroid with a narrow duct emerging from its dorsal surface. The white colored spermathecal duct passes ventrally along the albumen gland and oviduct to the point where it joins with the oviduct, a short distance above the anterior common reproductive channel (Fig. 17). Thus, the vagina is very short. The creamy-white prostate gland is globular in shape, follicular in appearance and relatively small. It is composed of tubules about 1/2 the size of the ovotestis acini. The prostatic secretion passes into the vas deferens through 1 duct. The



FIGS. 11-21. *Succinea kuntziana*. 11, Shell; 12, Jaw; 13, Radular teeth; 14, Body pigmentation and kidney shape; 15, Ventral view of the reproductive tract; 16, Receptacula complex; 17, Terminal male and female genitalia; 18, Cross-section of the penis; 19, Cross-section of the penis-epiphallus junction; 20, Cross-section of the epiphallus; 21, Terminal male genitalia. Scale lines in mm.

penis is a tube with a strong outer wall and 8 inner longitudinal, finely ridged folds which project into the lumen (Fig. 18). There are crystals present on the crests of the folds. These crystals are especially concentrated near the posterior end of the penis. A shelf of tissue projects from the inner wall of the junction between the epiphallus and penis so that there is only a small passage into the epiphallus (Fig. 19). The inner folds of the epiphallus are coarse, few and without crystalline material (Fig. 20). The vas deferens departs from the apex of the epiphallus and immediately bends anteriorly (Fig. 21). Sometimes the epiphallus is also bent anteriorly. There is a well developed, muscular penial sheath which can be dissected to reveal an inner layer of longitudinal muscle fibers and an outer layer of circular fibers. The sheath entirely encloses the penis and epiphallus in approximately 1/2 of the specimens (Fig. 15). Part of the epiphallus projects from the penial sheath in the others (Fig. 17). In both cases, the proximal portion of the vas deferens is also enclosed within the penial sheath (Figs. 15, 17). It emerges through an opening on the inner side of the penial sheath, passes forward to the level of the vagina, bends posteriorly and continues for a short distance to the dorsal surface of the prostate gland. The vas deferens is relatively short and muscular in appearance. The penial retractor muscle is attached at the junction of the epiphallus and vas deferens (Fig. 21). The penial sheath is drawn around and attached to the penial retractor muscle in the specimens that have the epiphallus completely enclosed in the penial sheath. In the forms with an emergent epiphallus, only the inner side of the penial sheath is attached to the penial retractor muscle. The penial retractor muscle is long and inserts in the inner side of the body wall over the second intestinal loop on the animal's left side. The vagina and penis open into a very short, muscular anterior common reproductive channel which opens almost immediately to the exterior through a crescent-like genital aperture.

A brief anatomical description of the reproductive tract of *Succinea kuntziana* was given by Solem (1959) which follows in its entirety. "Talon [=receptacula seminis] unequally bilobed in many specimens. 'Free loop' of epiphallus completely contained within the penial sheath in a few specimens, partially protruding in the majority. Penis slender. Penial retractor inserting at junction of epiphallus and vas deferens, some fibers attaching to penial sheath. Penis and epiphallus undifferentiated externally except for a slight constriction at their junction, concealed by the penial sheath. Epiphallus sculptured internally by a series of longitudinal ridges. Penis with four to six unbeaded longitudinal ridges." The description given by Solem differs or is incomplete in regard to several points when compared to the specimens I studied: (1) He does not report the presence of a fecundation pouch; (2) the penis is quite substantial and not slender relative to other succineid species; (3) the epiphallus of my specimens had no crystals [=beads in Solem's description] and few longitudinal folds; (4) the penis contained crystals and at least 8 longitudinally ridged folds; (5) the second slight constriction indicates the junction between the penis and epiphallus; and (6) he did not describe the ovotestis, ovotestis duct, albumen and prostate glands, spermoviduct, oviduct, spermatheca and its duct, the vagina or genital atrium. The anatomical characteristics of the reproductive system of *S. kuntziana* are now more completely understood.

SUBGENUS *HYALIMAX* H. & A. Adams

Succinea (*Hyalimax*) *maillardi* Fischer[3]

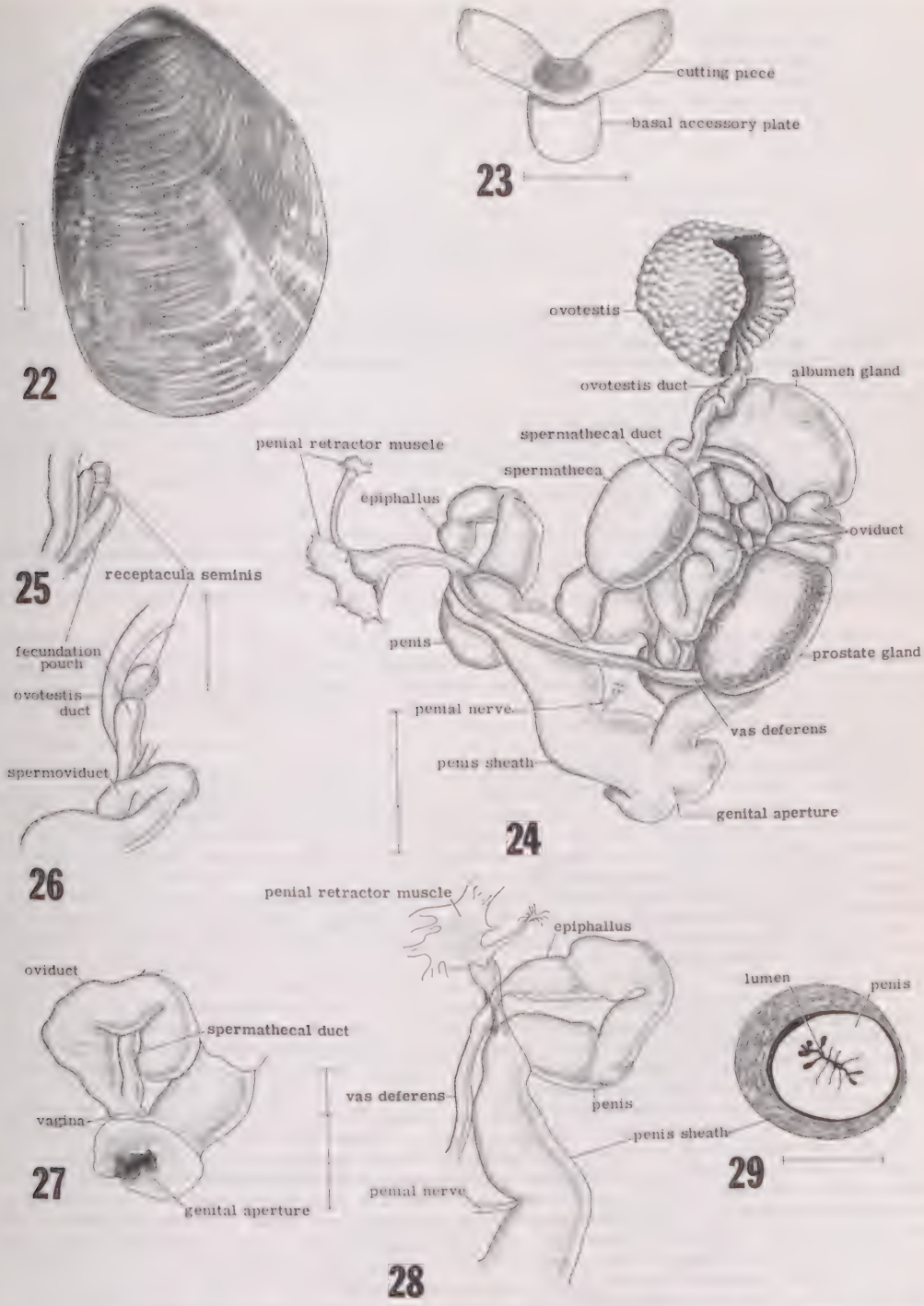
Shell

Three alcohol fixed specimens of *Hyalimax maillardi* Fischer (1867) from La Réunion (lot No. 403) were kindly sent to me by Mr. John Peake from the collections of the British Museum (Natural History), London. The shells of these succineid slugs are completely covered by the mantle. The delicate shells easily become broken, even when attached to the animal. The shells of both of the specimens I used in this study were broken along the periphery. However, the following morphological features could be described for the shells of these specimens. The larger shell measures 9.5 mm in length and 6 mm in width (Fig. 22). It is very slightly arched and has a calcareous appearance. The apex consists of only a very slight half-whorl. Distinct growth striae are evident. Several distinct transverse striae extend from the nucleus to the right anterior border. Fischer (1867) did not describe the shell of *H. maillardi*.

Jaw

The jaw of *Hyalimax maillardi* (Fig. 23) is thin and flexible. Its appearance is somewhat different from that of other succineids I have studied. The jaw is very much wider than high as measured at the greatest dimensions, which is one of its most striking features. The anterior margin of the cutting piece forms a shallow concave outline and is without a median prominence. Although the cutting piece has great breadth, it is not very strong. It is sculptured with many fine transverse striae, which is another unique feature. The basal accessory plate is narrow with slightly convex sides and an even posterior

[3] *Hyalimax* has been considered a distinct genus prior to this study.



FIGS. 22-29. *Hyalimax maillardi*. 22, Shell; 23, Jaw; 24, Ventral view of the reproductive tract; 25, Receptacula complex, dorsal view; 26, Receptacula complex, ventral view; 27, Terminal genitalia; 28, Terminal male genitalia; 29, Cross-section of the penis. Scale lines in mm.

margin. The jaw is a soft golden color with a dark brown-gold area on the central portion of the cutting piece. In his description of *H. maillardi*, Fischer (1867) said only that "...sa mâchoire le rapproche des *Succinea*;...La forme de la mâchoire des *Hyalimax* les distingue de ces divers genres." Fischer illustrated the jaw of *H. maillardi* (pl. 10, fig. 7); his diagram corresponds rather well with the observations on the jaw of specimens used in my study. However, he shows a slight median prominence which is absent in my specimens.

Radula

The radular formula of the 2 specimens of *Hyalimax maillardi* studied here is 145:1:145. There is no clear-cut difference between lateral and marginal teeth. Some of the admedian teeth are tricuspid, while others are bicuspid. The latter condition is usual for succineids. There is also some variability in the central teeth, some having 1 or both small cusps bifid. There is an anterior projection on all teeth in the plane of the basal plate. On the central and first few lateral teeth the large cusp is about 1/2 the length of the base.

Fischer (1867) did not give a radular formula for *Hyalimax maillardi* but did illustrate the central and some lateral teeth. These appear to be somewhat different from those of my specimens because he shows no anterior projection and broader bases than are seen on my specimens.

Anatomy

The specimens of *Hyalimax maillardi* were rather contracted and probably most of the natural color had faded due to the long period of preservation. Therefore, little can be said about external body features. However, the internal anatomy of the reproductive tract was clearly discerned.

The largest preserved specimen measures 25 mm in length and 10 mm in width. The only evidence of external pigmentation are the brownish colored lines on top of the head and the line along the posterior dorsal foot region. There is an indication of some frequently occurring small patches of pigment on the portion of the mantle covering the shell. The kidney is rather broad and nearly longitudinal with the body axis, a condition also seen in the slug-like *Omalonyx*. The location of the pneumostome is the same as in Fischer's specimens of this species (just posterior of the middle of the mantle edge on the animal's right side).

A ventral view of the reproductive tract of *Hyalimax maillardi* is shown in Fig. 24. The ovotestis is moderately large, creamy-beige in color and composed of many acini of varying sizes. The ovotestis duct emerges from the ventral surface of the ovotestis. It has a shiny golden appearance and is folded occasionally along its moderate length. The mid-portion of the ovotestis duct was not enlarged like the seminal vesicle of other succineids, but this condition probably varies with the reproductive phase. The 2 receptacula seminis lie in the groove dorsal to the ovotestis duct and hence are not visible in Fig. 24. The 2 receptacula seminis are of unequal size (Figs. 25, 26) and have the same shiny golden color as the ovotestis duct. There is a well developed fecundation pouch closely appressed to the receptacula seminis (Figs. 25, 26). The albumen gland is composed of numerous very tiny tubules, is relatively small, less elongate than in most succineids and has an orange tinge of color. The ducts of the ovotestis, receptacula seminis, fecundation pouch, albumen gland and vas efferens all open into the same region of the spermoviduct. The spermoviduct is a solid cream color, has moderately thick walls and is compactly folded. The posterior portion of the oviduct has the same appearance as the spermoviduct. The color changes to a light beige anteriorly and the oviduct walls become thicker and highly muscular near the anterior terminis. The spermatheca is a light cream color, oval-spheroid in shape and moderately large. Its duct departs from the dorsal surface, passes between the oviduct and prostate gland and joins with the oviduct just posterior to the anterior common reproductive channel (Fig. 27), leaving only a short vagina. The prostate gland is an oval-spheroid of moderate size, light beige in color and composed of many small tubules. The prostatic secretion passes along a short duct to the vas deferens which courses along the dorsal surface of the prostate gland. The penis is relatively long (Fig. 28) and is surrounded for about 1/2 of its length by a penial sheath. The penial sheath is very thick around the lower 1/4 of the penis (below the insertion of the penial nerve) and is especially heavy at the base (Fig. 29). The penis is convoluted in 1 turn and folded from its point of emergence from the penial sheath. The epiphallus is very short and externally it is not very distinctly demarcated from the penis. The penis is extremely thick-walled anteriorly (Fig. 29), but has a thinner wall posteriorly. Internally the penis is lined with diamond-shaped tissue folds which are studded with numerous small crystals. The epiphallus is separated from the penis internally by a lumenal tissue fold leaving only a small passage between the penis and epiphallus. The long transverse folds of the inner wall of the epiphallus are devoid of crystalline material. The vas deferens passes anteriorly from the prostate gland, under the right tentacle assembly and then posteriorly to join with the posterior end of the epiphallus. The vas deferens is a rather narrow, thin-walled duct. There is a very short, heavy penial retractor muscle which envelops the epiphallus-vas deferens junction and attaches to the penial sheath. The penial retractor muscle inserts broadly in the body wall just posterior to the anterior intestinal loop. A penial retractor muscle branch attaches to the spermatheca. An anterior common reproductive channel is scarcely formed before it opens to the exterior through a rather large genital

aperture. The body wall immediately around the periphery of the genital aperture is very muscular.

Fischer (1867) briefly described the reproductive anatomy of *Hyalimax maillardi*. He showed (pl. 10, fig. 9) the spermatheca opening separately into the common genital channel (no vagina existed), a different penial structure and penial retractor muscle attachment. However, the details of his illustration and description are not sufficient to make valid comparisons between his specimens and those used in my study.

The anatomical features of the specimens used in this study indicate that *"Hyalimax"* has a *Succinea* type of reproductive anatomy. However, the radula and jaw of *"Hyalimax"* vary somewhat from that of most *Succinea* examined to date.

GENUS *OXYLOMA* Westerland

Oxyloma cleopatrae (Pallary)

Shell

Specimens of *Oxyloma cleopatrae* were collected by Dr. B. C. Dazo from a drainage ditch at the airport in Alexandria, Egypt, May, 1965. The shell is attenuate, slender and colored a dull amber. It is thin and fragile, translucent around the outer apertural margin and somewhat glossy inside. There are 3 1/2 whorls which have slightly depressed upper peripheral margins (Fig. 30). The sutures are moderately impressed. One of the large shell specimens measures 18 mm in length and 8 mm in width. The aperture has an elongate pear-shape and measures 13 mm in length. The spire is short. There is a small, thin columellar plait. There is no columellar fold. The shell is sculptured with many fine growth lines. All of the shells had mud deposited on them. The shell of specimens used in this study are comparable to the type specimen in the UMMZ collection (no. 122845).

Jaw

The jaw of *Oxyloma cleopatrae* (Fig. 31) is slightly wider than high and has an amber color with darker medium brown areas on the cutting piece and basal accessory plate. The arms of the cutting piece are stout and have rounded anterior ends. The anterior margin of the cutting piece is convex with a well defined median prominence. The basal accessory plate is nearly square with a straight posterior margin.

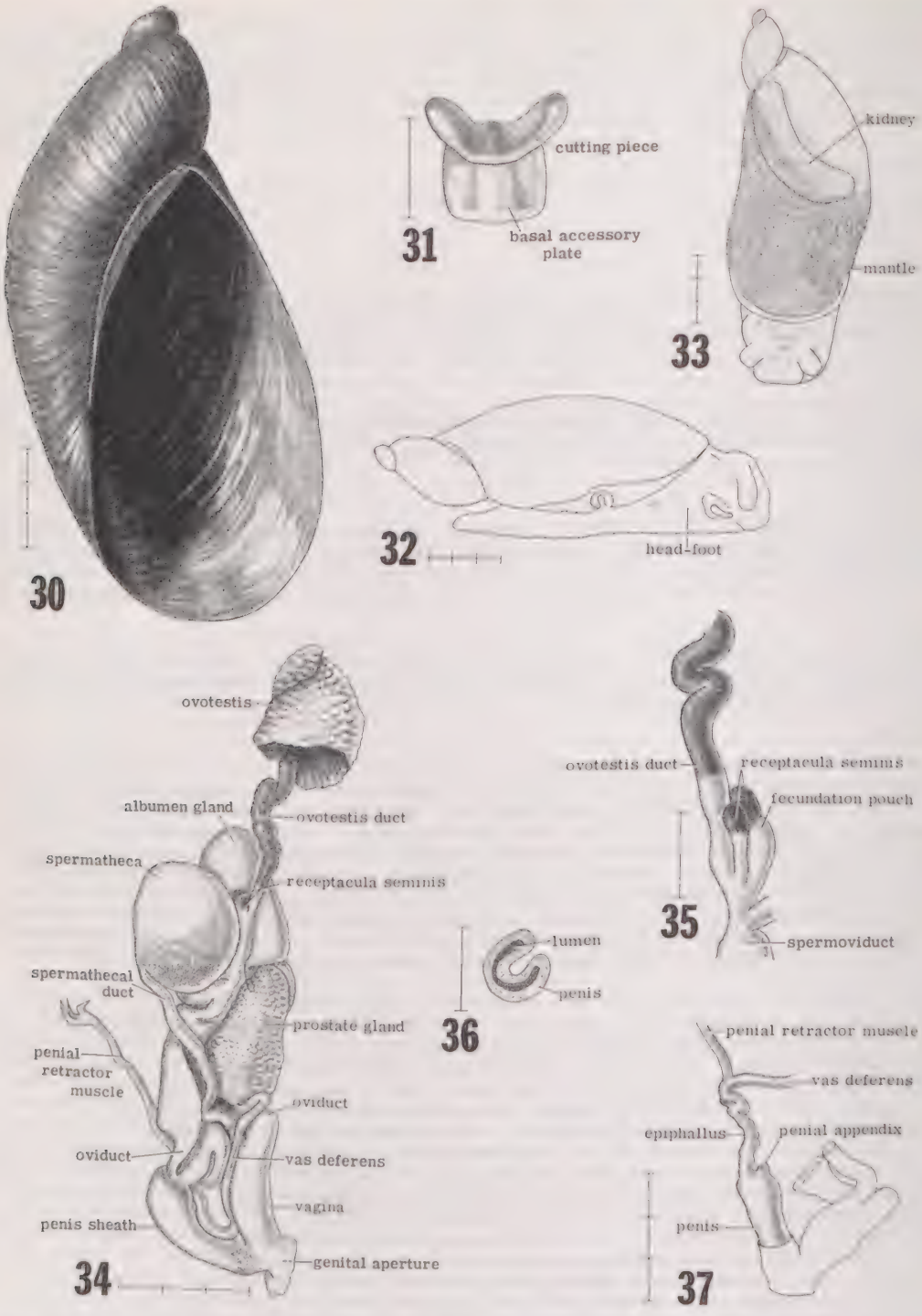
Radula

The radular formula for *Oxyloma cleopatrae* is 31:8:1:8:31 with a slight amount of variation in the number of marginal teeth. The marginal teeth are distinct. The inside edge of the base of the lateral teeth is decidedly oblique with an irregular margin.

Anatomy

The head and head-foot portions of the animal are pigmented with a light gray color. The pattern of pigmentation of *Oxyloma cleopatrae* is somewhat variable with a usual type shown in Fig. 32. The sides of the foot are also similarly pigmented with small patches of gray. Since these specimens have been preserved for several years, I do not know if the gray color is due to fading of black or is the natural color. The edge of the mantle in the region of the respiratory pore is also slightly pigmented. The mantle is pigmented with small distinct black dots. This pigmentation is more dense on the anterior portion of the mantle and becomes sparse in the region of the mantle covering the digestive gland and ovotestis (Fig. 33). The shape of the kidney is shown in outline in Fig. 33. In preserved specimens, the kidney is a translucent white color. The foot of a large specimen is of moderate length (13 mm) and slender (4 mm), tripartite and has a translucent white color. The shell apex extends beyond the end of the foot in preserved specimens.

Fig. 34 shows a ventral view of the reproductive tract of *Oxyloma cleopatrae*. The ovotestis is of moderate size and occupies a large portion of the posterior 1 1/2 whorls, giving the gland a twisted appearance. It is distinctly follicular in appearance and has a white color. The acini are of varying sizes, the largest being twice the size of the smallest, which are approximately equal in size to the tubules of the prostate gland. The apical portion of the ovotestis is sparsely pigmented with distinct dots of black. The ovotestis duct is of moderate length, slightly folded and almost solidly pigmented black in most specimens. The pigmentation, however, abruptly ceases a short distance posterior to the tips of the receptacula seminis (Fig. 35). The major portion of the ovotestis duct is slightly enlarged to serve as the seminal vesicle. There are 2 receptacula seminis of distinctly subequal length (Fig. 35). Both are pigmented with black on their apical portions. There is a well developed fecundation pouch which is devoid of pigmentation. It is a translucent white color with its interior channel clearly visible. The ducts of the ovotestis, receptacula seminis, fecundation pouch, albumen gland and vas efferens all join with the upper spermoviduct which is solid white and has a glandular appearance in its uppermost portion where the various channels join with it. The albumen gland is follicular in appearance, solid creamy white in color, of moderate size and spherical in shape. The spermathecal duct is relatively long and sometimes has a 1/2 fold before it enters the oviduct. The walls of the spermathecal duct become quite muscular as it enters the oviduct along the straight portion at a level approximately 3/4 of the distance from the genital aperture and the



FIGS. 30-37. *Oxyloma cleopatrae*. 30, Shell; 31, Jaw; 32, Body pigmentation; 33, Mantle pigmentation and kidney shape; 34, Ventral view of the reproductive tract; 35, Receptacula complex; 36, Cross-section of the penis; 37, Terminal male genitalia. Scale lines in mm.

apex of the first bend of the oviduct. The spermoviduct has a translucent white appearance and is compactly folded along its length. The uteral portion of the oviduct is very wide and folded ventrally. The oviduct becomes more muscular near the point where it bends anteriorly and the spermathecal duct joins it. The vagina is of moderate length and is highly muscular. The common terminal reproductive channel is relatively short but highly muscular with thick walls. It opens to the exterior through the slit-like genital aperture. The prostate gland is elongate, pear-like in shape and follicular in external appearance. The tubules forming the gland are numerous and small. They open along the length of the vas deferens which courses on the dorsal surface of the prostate. The prostate gland is without external pigmentation and is white in color. The vas deferens is folded as it departs from the anterior end of the prostate gland and courses anteriorly as it makes a bend at the level of the junction of the penis and vagina. It then courses posteriorly to the point where the penial retractor muscle attaches to the penial sheath, vas deferens and epiphallus. The vas deferens appears to "emerge" through an opening in the penial sheath. The penial retractor muscle is very well developed and courses posteriorly from its origin at the junction of the epiphallus and vas deferens to its insertion in the body wall just posterior to the first intestinal loop on the left side of the body. The penis is a simple tube, one wall of which in preserved specimens seems to be collapsed to form a U-shape in cross section (Fig. 36). The inner side of the penis is thickly studded with white crystals. They do not appear to be organized in any particular fashion. This condition is reminescent of that reported by Quick (1933, 1936) for some European and other African *Oxyloma* species. The penial appendix is reduced to a small knob on 1 side of the apex of the penis (Fig. 37). In some specimens it is reduced to a point of being scarcely noticeable as only a tiny bump. Opposite the penial appendix, the epiphallus emerges from the apex of the penis. The epiphallus is equal to or slightly longer than the penis. It is convoluted and folded compactly so that it occupies only the upper 1/3 of the sac-like penial sheath. The penial sheath is of moderate thickness and of the usual type consisting of an inner layer of longitudinal fibers easily separable from a strong outer layer of concentric (circular) muscle fibers. It completely encloses the penis and epiphallus. The anatomy of *O. cleopatrae* has not been previously described.

GENUS *OMALONYX* Orbigny
Omalonyx felina Guppy

Shell

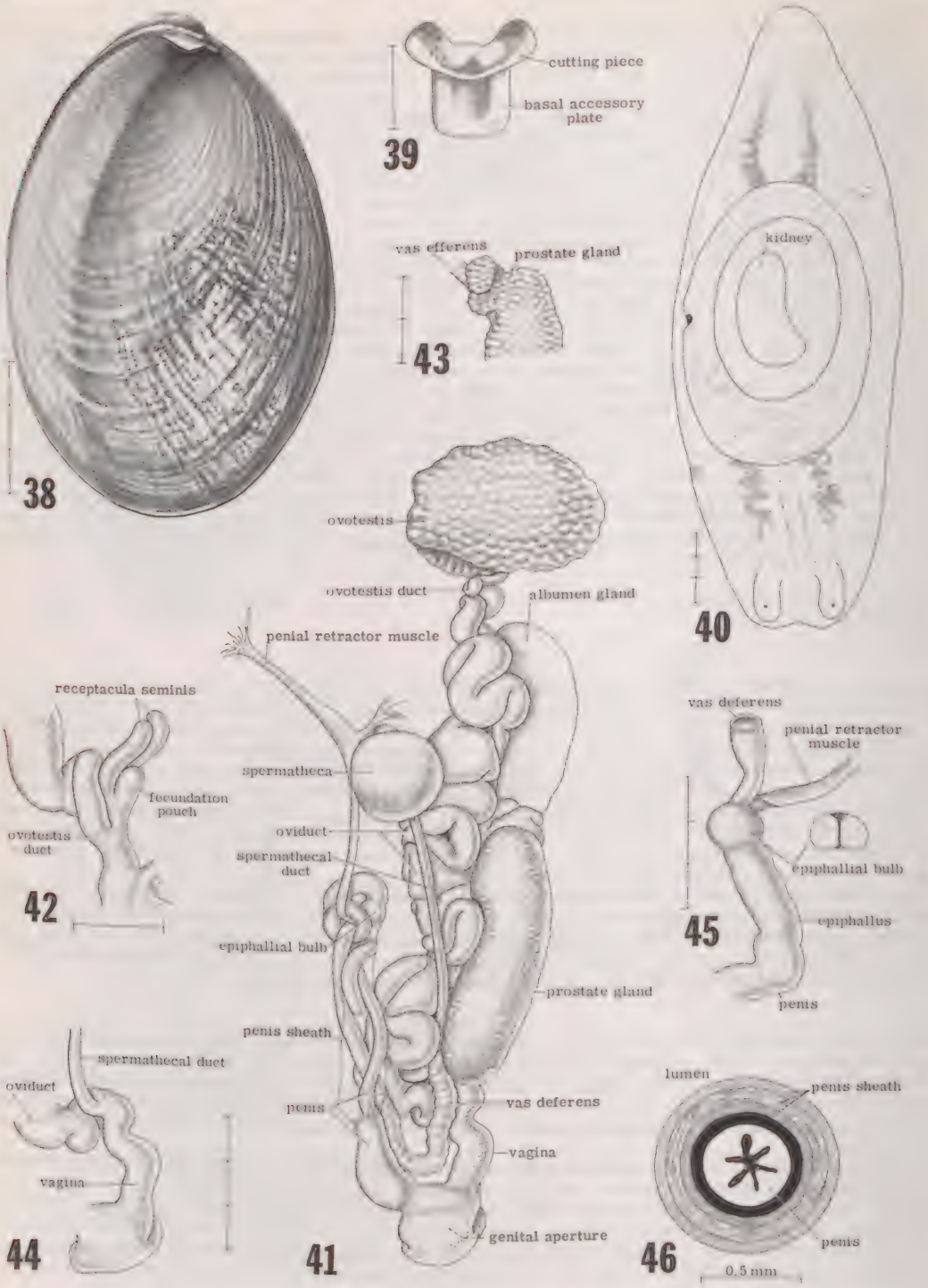
Specimens of *Omalonyx felina* were collected in Antigua in 1967. Several identified living specimens were kindly sent to me by Dr. D. S. Dundee. Sixteen generations were subsequently reared in the laboratory over a period of 2 years. The shell of the largest individual measures 11.5 mm in length, 7.3 mm in width with an aperture length of 11 mm (Fig. 38). The shell is very depressed in side view and has only 1 1/4 whorls. There is no spire. The aperture occupies almost the entire shell and is oval in shape. There is no columellar plait but there is a noticeable columellar flange which projects into the aperture. The shell is very thin, transparent and light amber in color. The coloration is slightly darker at the apex. The shell is sculptured with fine, readily visible growth lines and some widely spaced radial lines which can be seen only with transmitted light. The shell has a glossy appearance inside and out. The edge of the mantle encircles the peripheral 2 mm of the shell.

Baker (1925) gave an outline drawing of the shell of *Omalonyx felina* collected in Venezuela. His illustration is comparable to the specimens used in this study; especially the shape and columellar flange. A comparison with specimens in the UMMZ collection also shows the specimens used in this study to be similar in every regard to the identified shells of *O. felina*. However, some of the shells of laboratory reared individuals do become larger than those collected by Baker in Venezuela.

Jaw

The jaw of *Omalonyx felina* is shown in Fig. 39. It is slightly wider than high when measured at the greatest dimensions. It is a light amber color with a dark brown area on the cutting piece and a light brown area on the basal accessory plate. The arms of the cutting piece are rounded, the posterior margin is regular while the convex anterior margin has a gentle median prominence. The basal accessory plate is nearly square with a straight posterior margin. The cutting piece appears to be strong, but the accessory plate is weaker.

The illustration of the jaw of *Omalonyx felina* shown by Baker (1926, pl. 16, fig. 83) is slightly different from the condition observed in the Antiguan specimens. He shows the posterior margin of the basal accessory plate to have a sinuosity in the middle while the margin is straight in my specimens. The sides of the basal plate of Baker's specimens is slightly oblique but is more nearly vertical in my specimens. The arms of the cutting piece of my specimens do not seem to "flare out" quite as much as shown in Baker's illustration. However, such variability is not unexpected, especially from such widely separated populations.



FIGS. 38–46. *Omalonyx felina*. 38, Shell; 39, Jaw; 40, Body pigmentation and kidney shape; 41, Ventral view of the reproductive tract; 42, Receptacula complex; 43, Prostate gland extension; 44, Terminal female genitalia; 45, Penis-epiphallus-vas deferens junctions; 46, Cross-section of the penis and penial sheath. Scale line in mm.

Radula

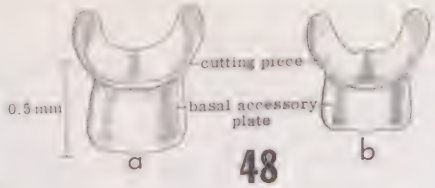
The radular formula for the Antiguan *Omalonyx felina* is 22-23:14:1:14:22-23. There was almost no variation in the number of teeth except a few specimens have 22 rather than 23 marginal teeth. There are no distinctive characteristics in the radula of *O. felina*.

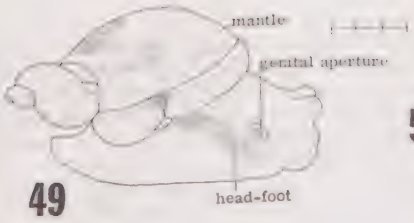
Baker (1926) gave the radular formula of 20-21:10-11:1:10-11:20-21 for the Venezuelan specimens. Although the formulae of the 2 populations differ considerably, his description of the teeth is similar to the condition observed in the Antiguan *Omalonyx felina*.

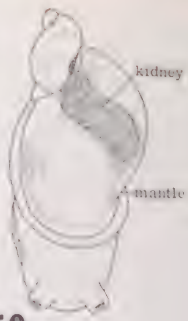
Anatomy

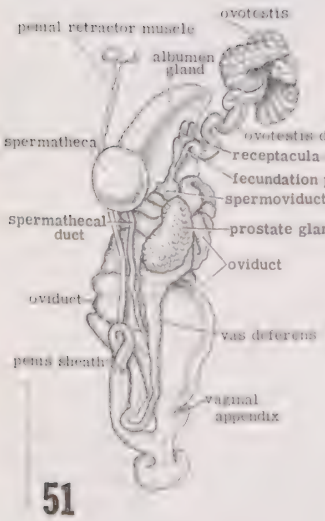
The body of living *Omalonyx felina* is a translucent white color with prominent black pigment markings. The twin black pigment stripes are very distinctive (Fig. 40). As shown in Fig. 40, *O. felina* has a slug-like body form. The foot of the large individuals is 33 mm long and 14 mm wide. The internal organs in the head region can be seen through the body wall. The edge of the mantle covers the border of the shell which aids in the retention of the flattened shell on top of the visceral mass of the snail. The kidney has a soft yellow color and the shape shown in outline on Fig. 40.

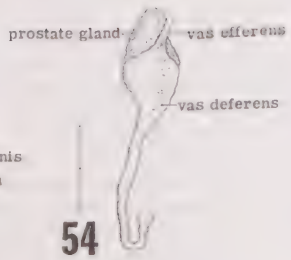
A ventral view of the reproductive tract is shown in Fig. 41. The white-colored ovotestis is moderately large with many acini. The ovotestis duct is long, distended and convoluted in its major portion which functions as the seminal vesicle. The seminal vesicle portion has a cream-colored appearance. The ovotestis duct narrows at each end and has a more solid white color than the seminal vesicle area. There are 2 receptacula seminis which are translucent white and subequal in length (Fig. 42). A well developed fecundation pouch is present. The albumen gland is creamy yellow in color, large, follicular in appearance, linguiform in shape with the anterior portion of the sides folded ventrally. The ducts of the ovotestis, receptacula seminis, fecundation pouch, albumen gland and vas efferens all join or depart from the upper spermoviduct near its origin. The spermoviduct is compactly folded along its length and has a white color. The white-colored prostate gland is large and oblong-spheroid in shape. Its many small tubules carry secretory products via many channels that join the vas deferens which passes along the dorsal surface of the prostate gland. These channels are readily visible through the wall of the vas deferens. At the posterior end of the prostate gland there is a small extension of the glandular tissue which continues for a short distance along the vas efferens (Fig. 43). This organ extension has not been recorded for any other succineid species. The white oviduct is extensive and composed of many tightly packed folds. Inner folds are slightly visible externally along the right uteral portion of the oviduct. The walls of the oviduct become somewhat thicker near the place where the spermathecal duct joins it. The vagina is extremely thick walled and of moderate length. The spermathecal duct joins at the apex of the first bend of the oviduct (Fig. 44). A small amount of crystalline material is present on the lumenal projections of the inner tissue folds of the vagina for a short distance up into the vagina. The inner folds of the vagina are similar to those (broadly diamond-shaped) of the terminal portion of the penis. The spermatheca is spherical, or nearly so, in shape, thin-walled and white in color. A branch of the penial retractor muscle attaches to the spermatheca. In some cases the muscle actually surrounds the spermathecal duct at its point of emergence from the dorsal side of the spermatheca. In most succineids, the spermatheca is supported independent of the penial retractor muscle. The anterior terminal portion of the penis is thick-walled, muscular and cylindrical in shape. Inner diamond-shaped folds of tissue project into the lumen. The crest of almost every fold is studded with several white crystals. The crystals are present along the entire length of the penis. The penis is surrounded by a heavy, muscular penial sheath (Fig. 46). This is composed of inner and outer layers of longitudinal muscle fibers and a middle circular layer of fibers. The usual penial sheath of succineids lacks an outer longitudinal fiber layer which can be dissected free of the circular layer. The penis becomes thin-walled and smaller in diameter approximately at the point where the penis is equal in length to the vagina. Also, at this point, the penial sheath becomes a thin, nearly transparent, sac-like structure which encloses the remaining length of the penis and the epiphallus. The penis is extremely long, which is a feature unique to *Omalonyx*. The inner diamond-shaped tissue ridges become less broad but visible externally along the convoluted, thin-walled section of the penis. The wall of the penis becomes thicker again as it nears the posterior terminis where it enlarges suddenly as it forms a junction with the epiphallus. There are no crystals inside the epiphallus, which is thick-walled with inner folds. The epiphallus is about 1/5 the length of the penis. There is a highly muscular bulb (Fig. 45) at the terminal end of the epiphallus from which the relatively thick-walled vas deferens emerges. This sort of epiphallial bulb has never been observed in another succineid. Its function is unknown. The vas deferens is not included within the sac-like penial sheath. The vas deferens passes dorsal to the penis and courses anteriorly. It becomes somewhat compacted at a level opposite the point where the penial sheath becomes heavy and muscular. The wall of the tubular vas deferens becomes thinner and translucent where it begins to appear compacted. The vas deferens continues anteriorly along the inner ventral side of the penis and then bends posteriorly, coursing along the inner ventral side of the vagina. It finally meets the dorsal surface of the prostate gland at the anterior end of the prostate. The penial retractor muscle is strong and originates at the point where the vas deferens emerges from the epiphallus. Insertion of the main branch of the penial retractor muscle is on the inside of the body wall rather low on the animal's left side

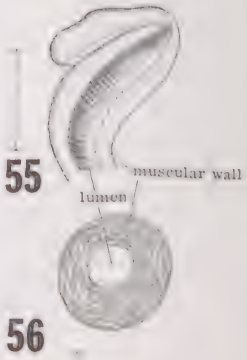


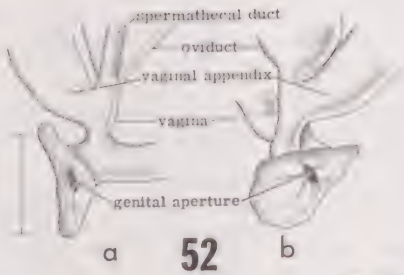


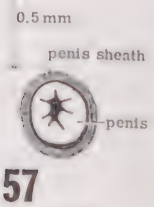


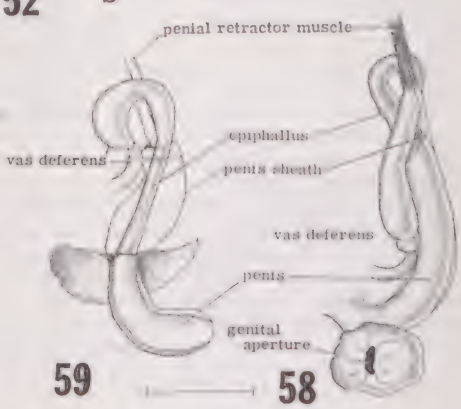












FIGS. 47–59. *Neosuccinea kofui*. 47, Shell; 48, Jaw; 49, Body pigmentation; 50, Mantle pigmentation and kidney shape; 51, Ventral view of the reproductive tract; 52, Terminal female genitalia; 53, Terminal male and female genitalia; 54, Vas deferens; 55, Vaginal appendix; 56, Cross-section of the vaginal appendix; 57, Cross-section of the penis and penial sheath; 58, Terminal male genitalia; 59, Everted penis. Scale lines in mm.

at a level opposite the pneumostome. The other branch attaches to and supports the spermatheca. The common terminal genital channel is wide, thick walled, muscular and short in length. It opens to the exterior as a rather long slit-like orifice.

An account of the anatomy of the reproductive system of the Venezuelan *Omalonyx felina* was given by Baker (1926). However, there are some differences between his description and the conditions observed in the specimens I studied. Baker reported an ovotestis composed of 2 sub-equal lobes. I do not find the ovotestis divided. He shows only 1 receptaculum seminis [=talon] whereas I see 2 distinct receptacula seminis. He reports "...scarcely an epiphallus..." while I find a distinct epiphallus 1/5 the length of the penis. The insertion of the penial retractor muscle is reported by Baker to be "...attached to diaphragm between liver and kidney near apex of visceral mass". The insertion is in the side of the body wall in the specimens I studied. Insertion in the body wall over the visceral mass is the usual feature of succineids. Thus, these specimens of *O. felina* may be quite atypical in the penial retractor place of insertion. Baker did not report the extension of the prostate gland tissue, the many prostate ducts leading into the vas deferens, the epiphallial bulb or the crystalline material inside the penis and vagina. Whether these features were present in the population he studied is unknown. He mentioned other features of the ovotestis duct, albumen gland, spermoviduct and oviduct, penis and associated structures and a short anterior common reproductive tract [=cloaca]. His description of the structures is similar to the conditions I observed.

GENUS *NEOSUCCINEA* Matekin

Neosuccinea kofui n.sp.

Shell

Living specimens were collected along side an irrigation ditch, Imasuwa, Shirane-machi, Nakakomagun, Kofu Valley area, Yamanashi Prefecture, Japan, in February, 1968 by Dr. J. B. Burch. Subsequent generations were reared in the laboratory. The shell (Fig. 47) is ovate-conical and has a soft amber-brown color. In its natural environment there is mud deposited on the outer shell surface. The shell is rather dull on the outer surface but very glossy inside. There are 3 whorls with moderately impressed sutures. The spire is about 1/3 the length of the shell. The shell is sculptured with prominent growth lines. There is a columellar plait without a distinct columellar fold. The aperture is ovate. The whorls are rounded on the periphery. The larger shells measure 9 mm in height by 6 mm in width; the aperture is 6 mm high. The type specimen has been deposited in the mollusk collection (UMMZ 231090), Museum of Zoology, University of Michigan. Paratypes have been sent to the National Science Museum, Ueno Park, Tokyo, Japan.

Jaw

The jaw is wider than high when measured at the greatest dimensions (Fig. 48a,b). It is amber in color with brown areas on the cutting piece and accessory plate. The cutting piece is strong with its anterior margin deeply curved posteriorly. There may be a small median prominence (Fig. 48b) or it may be entirely lacking (Fig. 48a). The sides of the basal accessory plate slant slightly inward. The posterior margin of the basal accessory plate may be nearly straight (Fig. 48a) or somewhat irregular (Fig. 48b). This species seems to have an unusual amount of variability in the jaw morphology.

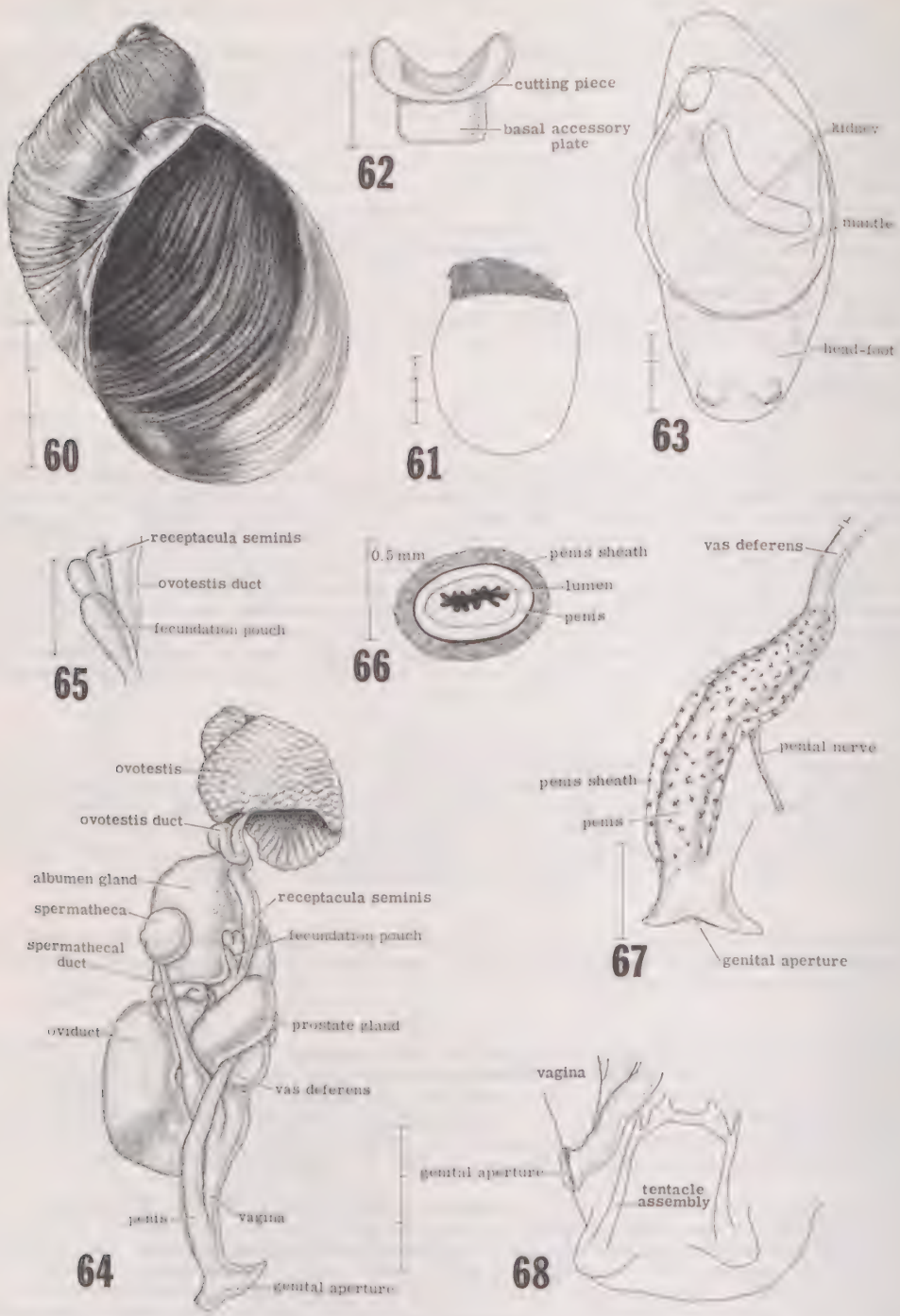
Radula

The radular formula of *Neosuccinea kofui* is 15-17:9:1:9:15-17. The marginal teeth seem to be the only ones to vary in number. There is nothing particularly distinctive in the form of the various radular teeth; they are similar to most other succineids.

Anatomy

The body of the living animal has a white appearance with pigmented areas of the mantle visible through the shell. There are prominent pigmented areas on the fore portion of the head-foot which are particularly noticeable (Fig. 49). The foot of adult specimens measures approximately 9 mm in length by 3.5 mm in width. Due to the thin translucent body wall, the internal organs occupying the anterior head-foot region are visible externally. The appearance of alcohol preserved specimens is the same. The mantle is usually extensively pigmented with black as shown in Fig. 50. The shape of the kidney is shown in outline on Fig. 50.

A ventral view of the reproductive tract of *Neosuccinea kofui* is shown in Fig. 51. The ovotestis is relatively small, composed of approximately 50-60 white-colored acini which are quite large in size. A sparse amount of black pigmentation may be present on the dorsal surface of the ovotestis. The ovotestis duct emerges from the center of the ovotestis as a thin, tenuous tube. It soon enlarges to form the seminal vesicle portion which is convoluted and heavily colored with black pigment. The duct becomes narrow again at its anterior terminis. There are 2 receptacula seminis of equal size with a well developed fecundation pouch adjacent to them. All are densely pigmented with black. The ducts of the ovotestis, receptacula seminis, fecundation pouch, albumen gland and vas efferens all join with the upper spermoviduct.



FIGS. 60-68. *Indosuccinea khandalla*. 60, Shell; 61, Debris deposition on the shell; 62, Jaw; 63, Body pigmentation and kidney shape; 65, Receptacula complex; 66, Cross-section of the penis and penial sheath; 67, Terminal male genitalia; 68, Terminal genitalia-tentacle assembly orientation. Scale lines in mm.

The albumen gland is yellow-cream in color, composed of many small tubules and linguiform in shape. The spermoviduct is white in color and very compactly folded along most of its length. Inner folds of the oviduct can be seen externally along the expanded uteral portion. The walls of the oviduct become heavier near the junction with the spermathecal duct and vaginal appendix. The spermatheca is spherical in shape, thin-walled and white in color. Its long duct is narrow and joins the oviduct a short distance above the junction of the oviduct and vaginal appendix (Fig. 52a, b). However, it continues along the inside surface of the oviduct as a visible duct anterior to its initial point of connection, its anterior most point being directly opposite the connection of the vaginal appendix with the oviduct. The vagina is short and has a thick muscular wall. The vaginal appendix debouches from the vagina (Figs. 52, 53). It is very thick-walled and highly muscular along its main portion (Figs. 55, 56). The posterior end is usually bent forward (Fig. 55) *in situ*. The lumen of the vaginal appendix does not contain prominent folds such as those found inside the penis and oviduct. The lumen has a smooth appearance internally. There is a tough, connective tissue covering the outside of the vaginal appendix. The tissue is closely appressed to the outer portion of the appendix wall. The function of the vaginal appendix is unknown. The prostate gland is small, white in color and composed of many small size tubules. There is usually some black pigmentation on the posterior ventral surface of the gland. The penis is enclosed in a penial sheath (Fig. 58). Inside, the penis has several folds of tissue which project into a central lumen (Fig. 57). The epiphallus, which projects out of the penial sheath in a single loop, is only slightly shorter than the penis but has a more muscular appearance. The penial sheath usually has a small amount of black pigment near its posterior end. An everted penis was observed in 2 relaxed specimens (Fig. 58). The vas deferens emerges from the end of the epiphallus as an enlarged duct for 1/4 of its length after which it suddenly constricts to a more narrow passageway. There is a connective tissue covering this enlarged muscular portion. The vas deferens courses forward to the level of the anterior common genital duct, then it turns posteriorly and continues along the inner ventral side of the uteral portion of the oviduct. As it approaches the dorsal surface of the prostate gland, it becomes greatly distended and extremely thin-walled (Fig. 54). This wide distention of the vas deferens has not been observed in any other succineid. There is a long, well developed penial retractor muscle which is attached at the vas deferens-epiphallus junction and also to the posterior end of the penial sheath. It inserts just anterior to the second intestinal loop on the left side of the animal. A few fibers insert in the supporting tissue just posterior and ventral to the kidney. The anterior common reproductive tract is short but very thick-walled and muscular. It opens to the exterior through a slit-like aperture which is expandable.

GENUS *INDOSUCCINEA* Rao

Indosuccinea khandalla Rao

Shell

Living specimens were collected from the leaves of mango trees, at an elevation of 1700 feet near Khandalla, Bombay Presidency, India, during the beginning of the rainy season in June, 1969. The shell of *Indosuccinea khandalla* is extremely thin, fragile and has the shape shown in Fig. 60. It is nearly transparent, especially the body whorl, and has a clear amber color. The shell becomes slightly thicker and opaque in the spire region. There are 2 1/2 whorls with an extremely short spire and a greatly expanded body whorl. The aperture comprises 85% of the shell length. This shell form is reminescent of some members of *Calinella* s.s. There is a prominent sculpture of regular spiral growth lines. The shell has a smooth appearance and is dull. A columellar plait is wanting and only a very minute columellar fold exists. A thick brownish-black colored coating of dried debris covered the upper portion of the body whorl and the spire of all individuals of this population (Fig. 61). Rao (1924) mentioned a similar "black deposit" on shells of *I. semiserica sthulasiras*. However, he did not mention its presence on specimens of *I. semiserica khandalla* from Khandalla which he examined. The largest shell of *I. khandalla* collected measures 12 mm in height by 7.5 mm in width. The shell of *I. khandalla* agrees with the description for this species given by Rao (1924).

Jaw

The jaw of *Indosuccinea khandalla* is very sturdy and wider than high when measured at its greatest dimensions (Fig. 62). The anterior margin of the cutting piece is concave posteriorly to form an open V-shape. A slight median prominence is present. The basal accessory plate has straight sides and a slightly irregular posterior margin. The jaw is colored a dull amber with a brown area on the cutting piece. The jaw of *I. khandalla* is similar to the form of the jaw for other *Indosuccinea* species.

Radula

The radula of *Indosuccinea khandalla* has a formula approximating 55:5:1:5:55, with some variability. The shape and number of cusps on the teeth is similar to that reported by Rao (1924) and Odhner (1950) for *Indosuccinea* ssp. However, there are 15-20 fewer marginal teeth in *I. khandalla* than described for the specimens examined by Rao and Odhner. Amin-ud-Din (1921) reported the number of marginal teeth to vary from 40-85 on each side of the radulae taken from Rangoon specimens.

Anatomy

In the living condition, the broad foot and body of the animal have a watery, translucent appearance. The anterior internal organs are visible externally through the body wall. The body of alcohol preserved specimens does not have the watery appearance but is still translucent. The mantle of most specimens is highly pigmented as shown in Fig. 63. The pigment patches on the side of the head-foot region are especially noticeable on both the living and preserved specimens. The kidney is white in color and was devoid of crystalline material. It is long and has the shape indicated in outline on Fig. 63.

A ventral view of the reproductive tract is shown in Fig. 64. The ovotestis is white, relatively large and has many acini. There are scattered black pigment spots on the outer surface of the gland. The ovotestis duct is rather long, convoluted and slightly distended in the mid-section which functions as a seminal vesicle. There are 2 receptacula seminis of equal length and a well developed fecundation pouch (Fig. 65). The ovotestis duct, receptacula seminis and fecundation pouch are covered by a thin connective tissue having scattered black pigmented areas. Ducts from the albumen gland, ovotestis, receptacula seminis, fecundation pouch and prostate gland (vas efferens) all lead into or depart from the upper spermoviduct. The albumen gland is shortened somewhat, but still has the linguiform shape characteristically found in succineids. It is composed of many very small tubules which have a creamy white color. There is also a thin lace-like sheet of black pigmented tissue covering the albumen gland. The spermoviduct has an appearance similar to the oviduct. They have a translucent, white color, thin walls and are compactly folded along their length. The right uteral portion of the oviduct may be folded or unfolded. The lower portion of the oviduct (the first 2 folds) has a somewhat thicker wall which becomes muscular in appearance near the junction with the spermathecal duct. The spermatheca is nearly spherical in shape, is white in color and relatively small. Its duct is of moderate length but becomes very wide along its anterior 1/3 as it joins with the oviduct. The wall of this enlarged portion also becomes heavy and has a muscular appearance. The vagina is moderately long; about equal to the length of the penis. It has a thick, muscular wall. The prostate gland is twisted into a spiralization so that the usual ventral surface of most succineids is dorsal in *I. khandalla*. The vas deferens courses along the ventral surface of the prostate gland rather than the normal course along the dorsal surface found in other Succineidae. Furthermore, the junction of the vas deferens with the prostate gland begins approximately in the center of the gland rather than at the anterior end, the condition observed in most other succineids. This type of twisted prostate gland has not been reported in any other succineid species. The prostate gland is white in color, composed of numerous small tubules and covered on the exterior with scattered black pigmentation spots. The penis is rather simple in structure consisting of a straight tube of moderate length which has a thick muscular wall and numerous tiny, longitudinally oriented folds on the interior surface (Fig.66). At the point of a slight dilatation of the penis, the interior folds begin to become slightly longer and slant in an oblique orientation. A short distance above this point commences the vas deferens which contains no internal folds. It does have a thick muscular wall similar to that of the penis. There is a conspicuous penis sheath present. It is heavy and thick near the base of the penis but becomes thinner posteriorly. It is prominently pigmented with black (Fig. 67). The pigmentation ceases at the point where the vas deferens begins. The penial sheath seems to be continuous with the tissue covering the vas deferens. The insertion of the penial nerve on the sheath is clearly seen (Fig. 67). In most succineids, the vas deferens is not surrounded by such a thick, muscular wall but usually a thin muscular layer instead. There is no penial retractor muscle. The common anterior genital duct is thick-walled, muscular and approximatey 1/2 the length of the vagina. It opens to the exterior through a slit-like orifice. The right tentacle assembly passes on the inside of the terminal reproductive complex (Fig. 68).

Amin-ud-Din (1921), Rao (1924) and Odhner (1950) all gave accounts of the reproductive anatomy of *Indosuccinea*. Amin-ud-Din pointed out the following reproductive tract features possessed by *Indosuccinea semiserica:* the spirally twisted prostate gland, a stout vas deferens, a penis sheath, the lack of a penial retractor muscle, an anterior dilation of the spermathecal duct and the separate opening of the penis, oviduct and spermathecal duct into the genital aperture. Apparently the specimens he examined did not have a vagina. In regard to *"Succinea" semiserica* he stated: "The reproductive organs are interesting in many respects, and belong essentially to a different type from those of the other species examined".

In 1924, Rao examined the specimens Amin-ud-Din studied and erected the genus *Indosuccinea*. Rao gave essentially the same account for the reproductive anatomy, but did not mention the presence (or absence) of a penial sheath. Rao found the receptacula seminis to be sometimes unequal in size and recorded the presence of a fecundation pouch. He also examined specimens of *Indosuccinea* from Khandalla. His description agrees in most respects to the condition I found in specimens from this locality with 2 exceptions: (1) He mentioned the absence of a fecundation pouch (it is present in the specimens I studied) and (2) he did not record the presence of a penial sheath. He believed the specimens from Khandalla to be sufficiently different from other *Indosuccinea* to designate them as *I. semiserica khandalla*. It is my opinion that the following distinct features of *I. s. khandalla*, in comparision to other *Indosuccinea* populations, support its elevation to full specific rank: (1) The presence of a longer penis which possesses a well developed penial sheath and (2) the joining of the spermathecal duct and oviduct to form a vagina nearly equal in length to the penis.

Odhner (1950) inconsistently agreed with Amin-ud-Din (1921) and Rao (1924) that no penis sheath exists. Odhner placed *Indosuccinea* in the subfamily Catinellinae which includes only forms lacking a penial sheath. Clearly, *Indosuccinea* does possess a penial sheath and hence cannot be included in Catinellinae. If there are species placed in *Indosuccinea* that do not have a penial sheath, they are not correctly included in that genus.

GENUS *LITHOTIS* Blanford

Lithotis rupicola Blanford

Shell

Living specimens of *Lithotis rupicola* were collected from the vertical face of rocks having abundant algae, a short distance from the waterfall at Khandalla, Bombay Presidency, India, in June, 1969. Water actually flowed down the rocks so that *Lithotis* was, in reality, living in an almost aquatic habitat. As the living snail moves, only the 2 tentacles project from underneath the shell. The shells were covered with debris which was especially thick on the posterior 1 1/2 whorls. After removing the debris, the shell is golden brown in color. It is sculptured with irregularly spaced wrinkled growth lines which give the shell a rough appearance. There are 2 1/2 whorls with the body whorl comprising 90% of the shell (Fig. 69a,b). The suture is very deeply impressed. The aperture is greatly expanded. There is a columellar plait and an untwisted columellar fold. The inside surface of the shell is glossy. The most prominent feature of the shell is a raised spiral ridge, which covers the pneumostome at the apertural margin. The shell is depressed to a modified limpet-like shape which is probably an adaptation to its habit of living in flowing water. One of the largest shells collected measures 6.5 mm in length and 5 mm in width. This description agrees with the original dessription given by Blanford (1863) and that in Rao (1925).

Jaw

The jaw of *Lithotis rupicola* is shown in Fig. 70. The length is nearly equal to the width. The cutting piece has a depressed, irregular anterior margin and rounded blunt arms. The jaw has an amber color with a brown tinge of coloration on most of the cutting piece. The sides of the basal accessory plate slant slightly inward anteriorly. The posterior margin of the basal plate is straight. There is no median prominence. Rao (1925) described the jaw of *L. rupicola* to be essentially the same except his illustration of the basal plate shows its sides bowing outward slightly.

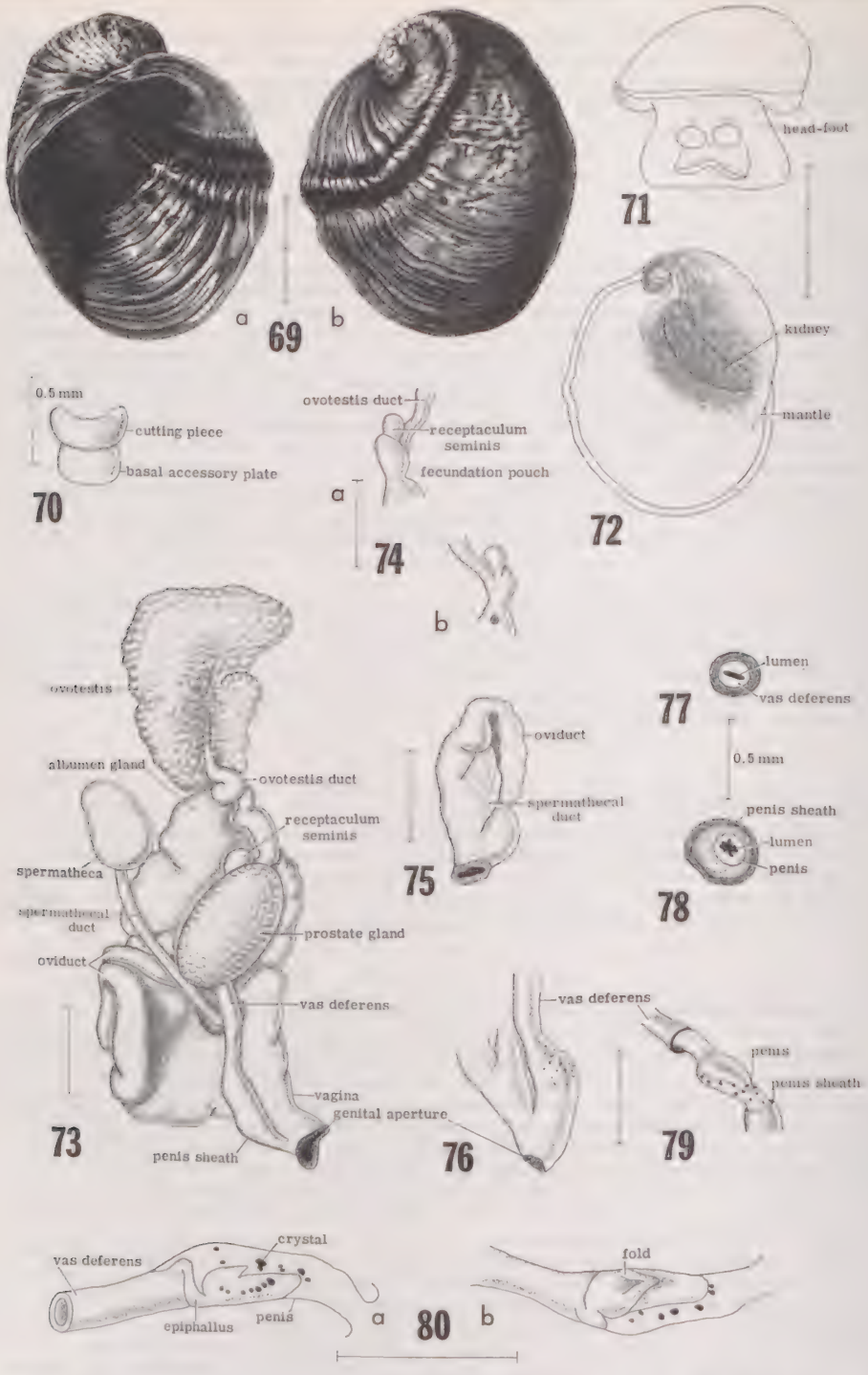
Radula

The radula formula for specimens of *Lithotis rupicola* used in this study is 18:6:1:6:18 with a small amount of variation. Rao (1925) reported a formula of 34:11:1:11:34. Apparently variation among populations is rather extensive. However, the form of the teeth is like Rao reported in the specimens he studied. They are rather unique among the Succineidae in several respects. Firstly, unworn central teeth have a mesocone (large cusp) which is longer than the base and there are no small cusps present (most other succineids have a tricuspid central). Secondly, the laterals have a similar long, large cusp; a second (small) cusp does not appear until the sixth and last lateral tooth. The marginal teeth have extremely short bases.

Anatomy

The foot of *Lithotis rupicola* is translucent white in color with small white, solid dots visible through the side wall of the foot. In relaxed specimens, the foot measures 5-6 mm in length by 3-4 mm in width. The head is pigmented with scattered black spots between the tentacles and mantle edge (Fig. 71). The rostral portion of the head is also pigmented with black spots which are in close proximity and give it a charcoal-gray color (Fig. 71) The head-foot measures approximately 5-7 mm in length. A prominent black pigmentation covering the tentacle assembly is clearly visible through the body wall. The mantle is pigmented with black and the pattern is rather constant (Fig. 72). The area of the mantle covering the kidney is pigmented solid black while the area over the digestive gland, immediately posterior to the kidney, is nearly solid black. The amount of coloration then decreases somewhat posteriorly to the apical tip. Anterior to the kidney, the pigment is in the form of radiating lines. Pigmentation is more sparse in this region and absent near the anterior mantle edge.

Fig. 73 shows a ventral view of the reproductive tract of *Lithotis rupicola*. The ovotestis is very large and follicular in appearance. The acini are of widely varying sizes with the largest ones present on the dorsal surface. The ovotestis is white and sparsely pigmented with black in scattered areas on the columellar surface. The ovotestis duct is relatively long, usually convoluted in at least 1 turn and quite densely pigmented with black on its outer surface. There is only 1 receptaculum seminis and a well-developed fecundation pouch (Fig. 74). Serial sections (paraffin) confirmed this observation. The receptaculum seminis is sparsely pigmented with black. The linguiform-shaped albumen gland is large, white in color and follicular in external appearance. The tubules forming the gland are relatively larger and less compactly organized than in most succineid species. The diameter of the albumen gland tubules is nearly the



FIGS. 69-80. *Lithotis rupicola*. 69, Shell - a, apertural view, b, dorsal view; 70, Jaw; 71, Body pigmentation; 72, Mantle pigmentation and kidney shape; 73, Ventral view of the reproductive tract; 74, Receptaculum complex - a, dorsal view, b, ventral view; 75, Terminal female genitalia; 76, Terminal male genitalia; 77, Cross-section of the vas deferens; 78, Cross-section of the penis; 79, Penis with penial sheath partially removed; 80, Penis - a, dorsolateral view, b, ventrolateral view. Scale lines in mm.

same as the diameter of the prostate gland tubules. The ducts that pass from the ovotestis, receptaculum seminis, fecundation pouch, albumen gland and to the prostate gland all lead to or from the upper spermoviduct. The spermoviduct and oviduct are compactly folded and translucent white in color. The uteral portion of the oviduct is very wide and folded ventrally toward the outside. The walls of the anterior portion of the oviduct become thick and muscular. Internal folds, although present, are not visible externally. The vagina, when it exists, is thick-walled and rather short. There is some variation in its length and in many smaller specimens it does not seem to be present at all (Figs. 75, 76). The terminal male and female reproductive tracts are separate from the opening of the genital atrium. Thus, a common terminal genital tract is almost wanting. The spermatheca is oblong-spheroid in shape with a long duct which widens greatly as it joins with the oviduct (Fig. 75). The internal folds of this wide portion of the spermathecal duct are sometimes visible externally. The prostate gland has a translucent white color, is follicular in appearance and has an oblong-spheroid shape (Fig. 73). The tubules of the prostate gland are rather loosely organized, somewhat like the condition in some *Quickia* species. The tubules join in 5-6 bunches which all converge at the same point where they connect from the dorsal surface of the prostate gland to the vas deferens. A small short duct (vas efferens) then joins directly with the upper spermoviduct. The penis is relatively short and contained within a thick sheath (Fig. 79), which is composed of an inner layer of longitudinal muscle fibers and a tough outer layer of circular muscle fibers (Fig. 78). The penial sheath is thicker near the base of the penis. There are often some black pigment marks on the upper part of the sheath (Fig. 76). The penis is tubular, enlarged posteriorly with an almost completely transparent, thin wall. A large double fold of tissue emerges inward from the left side of the penis wall (Fig. 80a, b). Within the penis are numerous white crystals. Some large crystals are free while other smaller crystals are adherent to the inner surface of the double fold of tissue. Occasionally the penis is twisted in a half turn just below the tissue fold. The penis narrows abruptly just posterior to the large internal fold to form a very short epiphallus (Fig. 80a, b) which has small folds within. The epiphallus is continuous with the vas deferens, which has a thick muscular wall (Fig. 77). The vas deferens has a straight course to the prostate gland (Fig. 73). The condition of the vas deferens is reminescent of that in *Indosuccinea khandalla*. The penial sheath is continuous with the muscular wall of the vas deferens. As in *Indosuccinea*, there is no penial retractor muscle and the right tentacle assembly is situated to the inside of the terminal genitalia.

Rao's (1925) report includes the only other study of the reproductive anatomy of *Lithotis rupicola*. He described briefly the features of the ovotestis and its duct, albumen gland, 2 receptacula seminis, spermatheca and its duct, oviduct and a penis having a club-shaped epiphallus but devoid of a penial retractor muscle. He did not mention the presence of a well-developed penial sheath. There are 2 major differences in the description given by Rao and the conditions I find in some of the reproductive structures. He stated "the seminal vesicles [=receptacula seminis]...consist of the usual pair of club-shaped sacs with a well developed fecundation pouch. They lie closely pressed together and except in good light under a high power of the microscope present the appearance of a single large sac." It was confirmed in this study that only 1 receptaculum seminis is present (Fig. 74). He further stated that "There is a club-shaped epiphallus...traversed by a wide duct which is often thrown into transverse folds in the upper part of its course. The surface of the epiphallus is usually covered by some foreign particles...". The structure Rao illustrated as the epiphallus is probably the double internal fold of the penis proper; the epiphallus is a very short tube extending between the upper somewhat bulbous portion of the penis and the vas deferens (Fig. 80a, b). The epiphallus is folded compactly in only 1 fold in the 8 specimens examined.

GENUS *CATINELLA* Pease

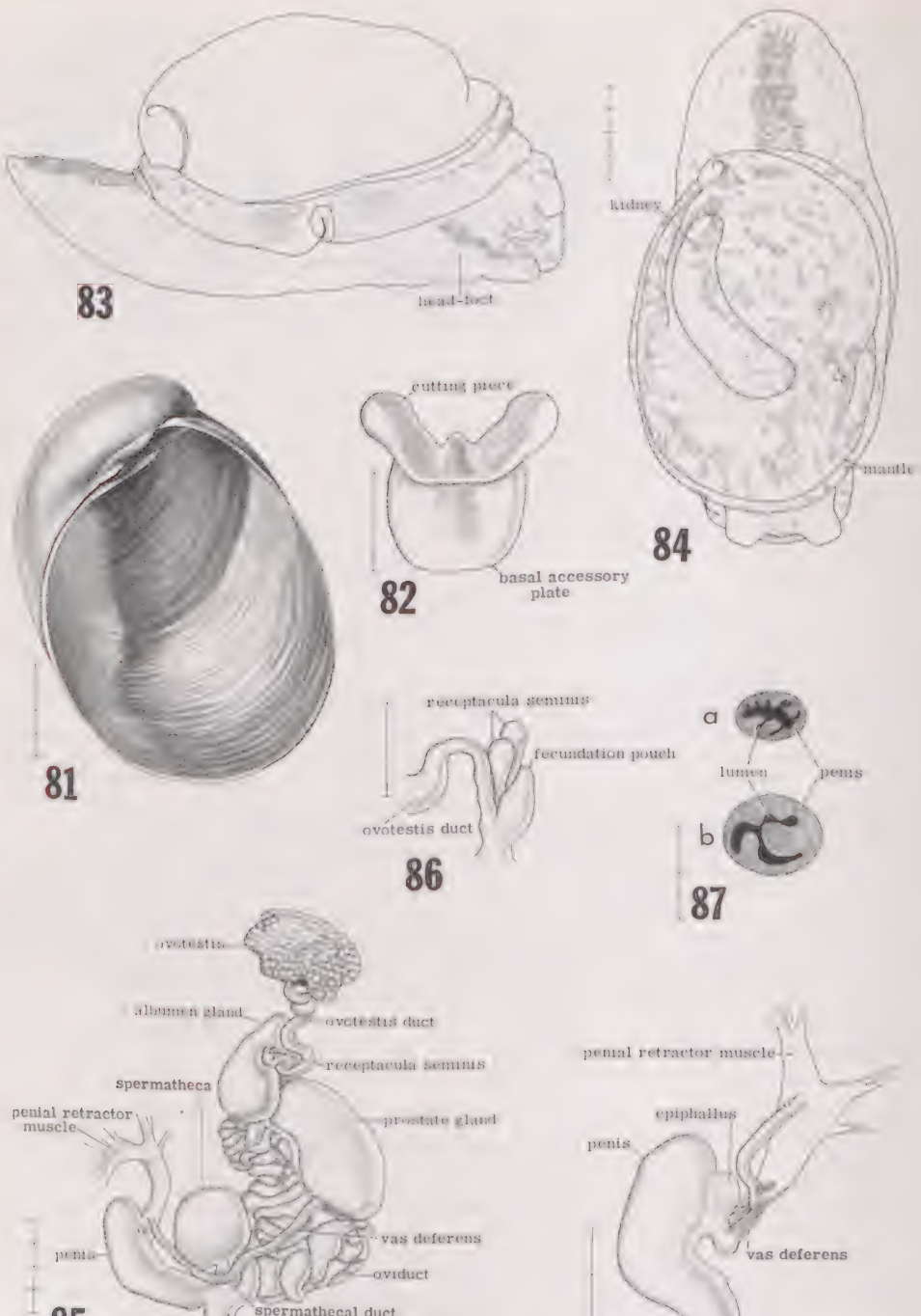
Catinella putamen (Gould)

Shell

Specimens of *Catinella putamen* used in this study were collected by Dr. Yoshio Kondo in 1967 at the following locations on Upolu Island, Samoa: (1) Malololelei, Upolu I., Samoa and (2) Laloanea, Upolu I., Samoa. The shells are large and ovate in shape. One of the largest measures 15 mm in height and 11 mm in width. The aperture is 13 mm high and broadly ovate. There are 2 1/4 whorls with the body whorl greatly inflated and occupying more than 4/5 of the shell length. The spire is depressed. The periphery of the whorls is rounded. A columellar plait is present. There is a blade-like edge along the columella. A columellar fold is lacking. The shell is dull outside and glossy within. It has a dull amber color with a distinct orange tinge, especially in the spire region. The shell is sculptured with fine growth lines and some widely spaced, nearly inconspicuous, transverse impressions. The sutures are weakly impressed. Fig. 81 shows an apertural view of the shell of *C. putamen*.

Jaw

The jaw (Fig. 82) of *Catinella putamen* is strong and wider than high when measured at the greatest dimensions. It has an amber color with medium brown areas on the cutting piece and basal accessory plate. The cutting piece is strongly chitinized and has a deeply curved anterior margin with a well-defined median prominence. The arms of the cutting piece have rounded anterior ends. The basal accessory plate is stout with slightly rounded sides and a straight posterior margin.



FIGS. 81–88. *Catinella putamen.* 81, Shell; 82, Jaw; 83, Body pigmentation; 84, Mantle pigmentation and kidney shape; 85, Ventral view of the reproductive tract; 86, Receptacula complex; 87. Cross-section of the penis – a, anterior, b, middle; 88, Terminal male genitalia. Scale lines in mm.

Radula

The radula of *Catinella putamen* is large and has a formula of 24:13:1:13:24. The marginal teeth are distinct from the laterals and have as many as 5 cusps. The mesocone of the central teeth is rather short and stout. In 1 specimen it was abnormally bifurcate near the tip. The radula is typically succineid in structure.

Anatomy

The head-foot of alcohol-preserved specimens of *Catinella putamen* has a solid white color with prominent dark black pigmented areas as shown in Fig. 83. The extensive black areas on the posterior end of the foot, the anterior sides of the head-foot and the top of the head are particularly noticeable. The mantle is highly pigmented with black (Fig. 84) and in 1 specimen was nearly solid black. The animal is large, perhaps the largest species of *Catinella* known. The foot of a preserved specimen measures 22 mm in length by 9 mm in width and is clearly tripartite. The kidney is white in color and has the shape shown in outline on Fig. 84.

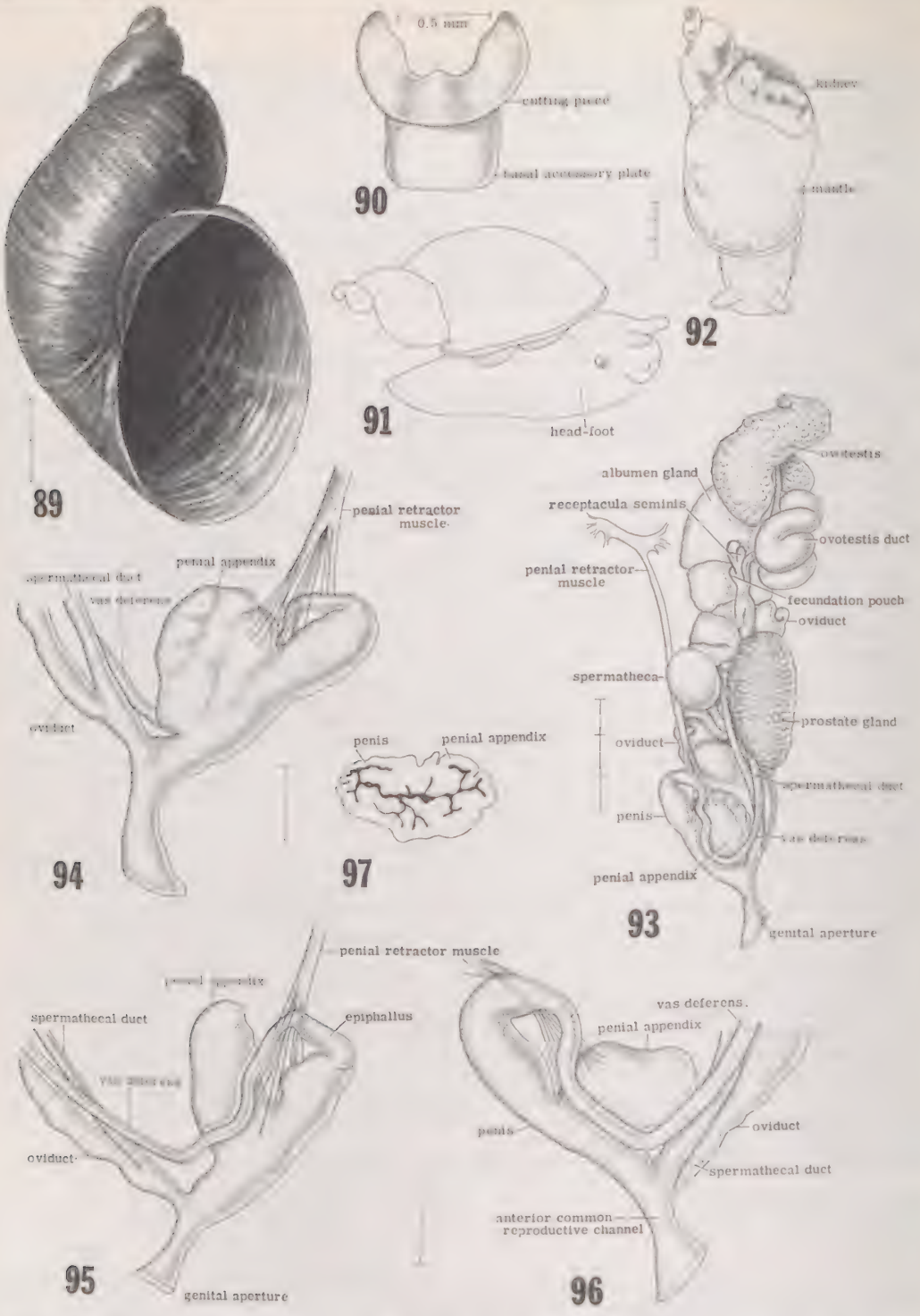
A ventral view of the reproductive tract of *Catinella putamen* is shown in Fig. 85. Due to the ventral "folding" of the reproductive organs, they are held apart with dissecting pins. Normally the organs are very compactly associated. The ovotestis is of moderate size and is white with an orange tinge of color. There is usually a sparse amount of black pigmentation on the dorsal surface of the gland. The ovotestis duct has the same color as the ovotestis and is rather long and convoluted in 5-6 turns. The duct is devoid of black pigmentation. The ends of the duct are very narrow while the mid-portion is distended and functions as the seminal vesicle. The ovotestis duct is devoid of black pigmentation. There are 2 white receptacula seminis of unequal size (Fig. 86). The ducts of the ovotestis, receptacula seminis, fecundation pouch and vas efferens all open into the upper spermoviduct. The albumen gland is of moderate size, has an orange tinge of color and is composed of extremely small tubules. It is linguiform in shape and has its sides folded underneath (ventrally). The spermoviduct and oviduct are solid white in color and compactly folded along their length. The oviduct is thick-walled and muscular from its anterior end to the apex of the first bend. The spermatheca is spherical in shape and colored with an orange hue. It is unique in being especially large and having an extremely short, wide muscular duct. It joins the anterior common reproductive channel directly so that a vagina does not exist. The prostate gland is large and bean-shaped. It is composed of many tubules about equal in size to those of the albumen gland. The prostate also has a tinge of orange color. The prostate gland appears to have a groove on its interior dorso-lateral surface through which the vas deferens passes as a rather wide duct. However, the prostate does not completely surround the duct. The vas deferens receives the secretory products of the prostate gland along its entire length. The penis is large, white in color, thick-walled and muscular in appearance. It has 1 very large fold and several smaller folds on the interior surface. Near its anterior end the cross section shows several small folds of tissue inside (Fig. 87a). At a level just anterior to the emergence of the epiphallus there is a very large fold and several smaller ones (Fig. 87b). There is a short epiphallus emerging from the interior lateral wall of the penis a short distance below the apex. The epiphallus is a wide duct which bends in an anterior direction first but soon makes a 1/2 turn posteriorly (Fig. 88). There is a small amount of black pigmentation on the proximal portion of the epiphallus. The vas deferens emerges from the distal end of the epiphallus as a white, translucent duct of small diameter. It passes forward to the level of the common reproductive channel, bends posteriorly and continues along the ventral surface of the oviduct. It widens slightly prior to joining with the inside dorso-lateral surface of the prostate gland. There is an extremely well-developed penial retractor muscle (Fig. 85, 88). Its fibers enclose the vas deferens and the distal 1/2 of the epiphallus (Fig. 88). The fibers also attach on the proximal portion of the epiphallus and then on the penis proper (Fig. 88). The effect is to hold the distal portion of the epiphallus closely appressed to the proximal part of the epiphallus and form an enclosure. The main insertion of the penial retractor muscle is in the body wall between the first and second intestinal loops on the left side of the animal. The other fibers attach in the mantle wall at the left of the kidney and in the supporting tissue of that general area. Two areas of attachment in the mantle are shown by circles of radiating lines on Fig. 84. The penis, spermatheca and oviduct all open simultaneously into the anterior common reproductive channel which is short, thick-walled and muscular. This tract opens to the exterior through an expandable slit-like genital aperture.

The anatomy of *Catinella putamen* has not been previously described.

SUBGENUS *QUICKELLA* Boettger
Catinella vermeta (Say)

Shell

Specimens used in this study were collected from muddy ground in a flood zone of the Kalamazoo River at Comstock Park, Comstock, Kalamazoo County, Michigan, U.S.A. during the summer months of 1968 and 1969. This particular population is composed of unusually large specimens. Fig. 89 shows the shell of 1 of the larger individuals. It measures 13.5 mm in length, 7 mm in width and has an oval-shaped aperture



FIGS. 89-97. *Catinella vermeta*. 89, Shell; 90, Jaw; 91, Body pigmentation; 92, Mantle pigmentation and kidney shape; 93, Ventral view of the reproductive tract; 94, Terminal genitalia (dorsal view); 95, Terminal genitalia (dorsal view); 96, Terminal genitalia (ventral view); 97, Cross-section of the penis and penial appendix. Scale lines in mm.

which is 8 mm high. The shell has 3 1/2 whorls, is attenuate-conical and has a dull amber-beige color. In its natural state, the shell is covered with mud which is easily removed. The sutures are deeply impressed. Closely spaced growth lines are the only sculptural features of the shell. The columellar plait is evident; there is no columellar fold. The shell is larger and the spire is more pronounced in these specimens as compared to specimens of *Quickella vagans* [=*Catinella vermeta*] examined by Pilsbry (1948). The largest specimen he examined was 7.5 mm in length and had 3 whorls. However, anatomical features of these specimens prove them to be, unmistakably, *C. vermeta*.

Jaw

The jaw of *Catinella vermeta* is chitinous and relatively strong (Fig. 90). The arms of the cutting piece are rounded on the outer sides and narrow on the ends. The anterior margin of the cutting piece is deeply convex with a median projection. The basal accessory plate is nearly square. The jaw is slightly wider than high. Pilsbry's (1948, fig. 414: 9) illustration of the jaw of *"Quickella vagans"* shows it to be similar in form to the jaw of specimens used in this study. However, the end of the arms of the cutting piece are flattened and the median projection is more pointed in his specimens. Such differences are within the expected population variations.

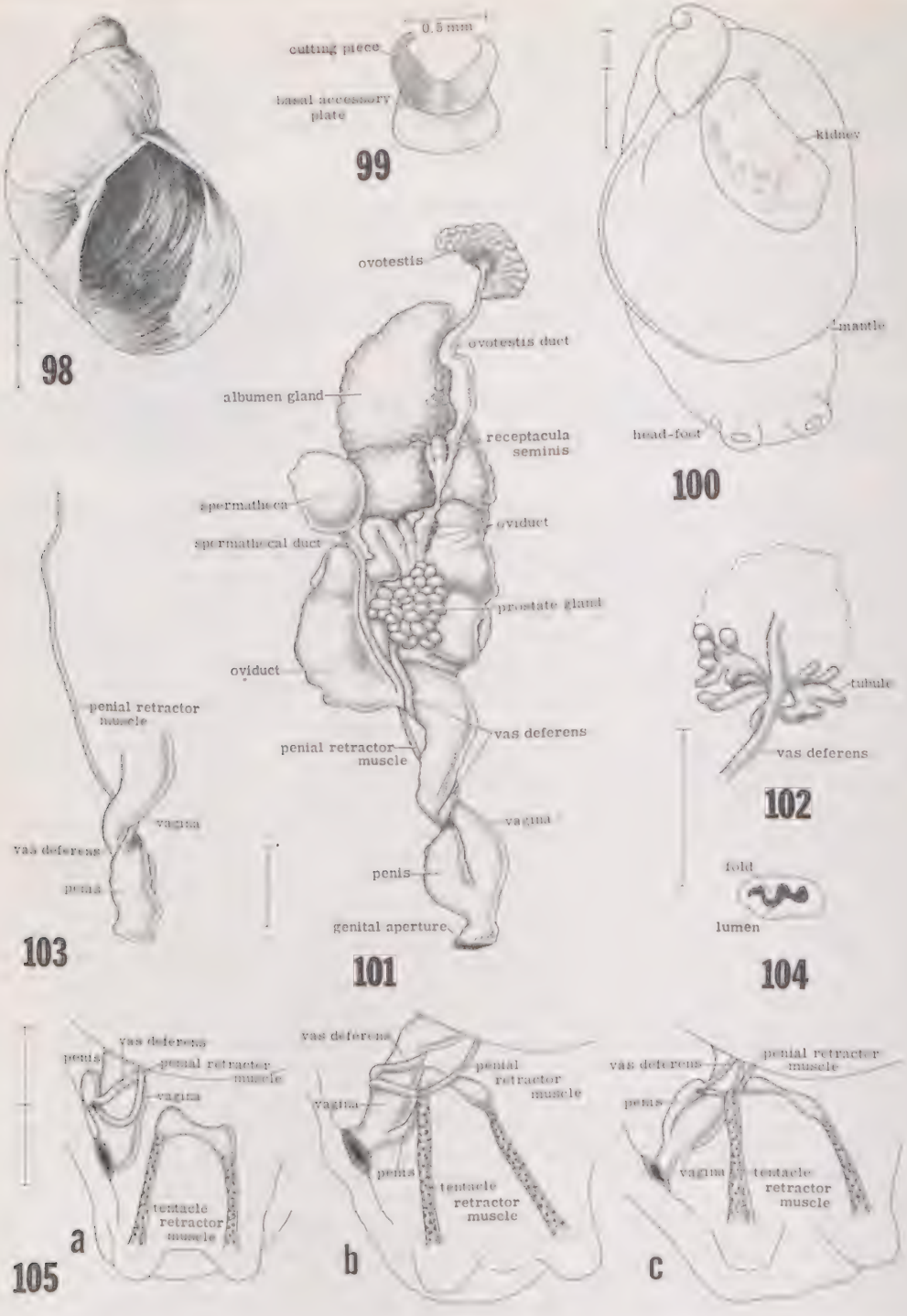
Radula

The radula of *Catinella vermeta* has the formula 9:9:1:9:9 with little or no variation in this population. The marginal teeth are clearly distinct. The radula of *C. vermeta* bears no unique characters and is typically succineid-like. Pilsbry (1948) did not discuss radular characters of the specimens he studied.

Anatomy

The body of preserved animals is a translucent white color with black pigment markings. All individuals have a highly pigmented mantle and head-foot region. Figs. 91 and 92 show the pigmentation pattern commonly encountered in the Comstock Park population. The shape of the creamy yellow kidney is shown in outline in Fig. 92. Pigmentation on top of the head and on the side of the head-foot occurs in blotches as shown in Figs. 91 and 92. The color has a gray appearance in these areas. The edge of the mantle is more deeply colored (Fig. 92). The terminal genitalia and other organs occupying the head region can be seen externally through the body wall. The sole of the foot is tripartite and has a translucent white appearance in living specimens. The foot of one of the larger specimens measured 13 mm in length by 5 mm in width.

A ventral view of the reproductive tract is shown in Fig. 93. The ovotestis is of moderate size, white in color, has many relatively small acini and is covered on its outer surface with a thin connective tissue which is pigmented with some black. The ovotestis duct emerges as a thin tube which becomes greatly enlarged and coiled in its midsection which serves as the seminal vesicle. The duct then becomes small as it joins with the ducts of the receptacula seminis, fecundation pouch, albumen gland and vas efferens in leading into or from the upper spermoviduct. The ovotestis duct is deeply pigmented black in its small sections and colored gray with sparse pigmentation in the region of the seminal vesicle. There are 2 receptacula seminis of unequal size which are colored with black. The fecundation pouch is well developed and also marked with black pigment. Upon leaving the posterior end of the prostate gland, the vas efferens of some individuals has some large star-like black pigment spots on its ventral surface. Pigmentation in this area has not been observed in any other succineid to date. The albumen gland is of moderate size, follicular in external appearance and has the usual linguiform shape. It is sparsely pigmented with black on its outer surface. The spermoviduct has a rather translucent white appearance and is compactly folded along its length. The prostate gland has an oblong-spheroid shape and is composed of tightly packed tubules which give it a follicular appearance externally. The prostate gland is also sparsely pigmented with black on its external surface. The walls of the oviduct become somewhat thicker than those of the spermoviduct and hence have a solid white appearance. However, internal folds can be seen externally along the lower oviduct although rather indistinctly. The spermatheca is nearly spherical and translucent white in color. Its duct has a straight course and joins with the oviduct near the anterior common genital channel leaving only a very short vagina. The lumen of the spermathecal duct is clearly seen externally in the vicinity of its junction with the oviduct. Internally the spermathecal duct has folds. The anterior common genital channel is 3-4 times the length of the vagina. Neither is noticeably muscular and the walls are relatively weak even though they are composed of some muscular tissue. The penis however is muscular in appearance, very ample in size and possesses a penial appendix which emerges a short distance above the base of the penis and is of variable shape and external appearance. Figs. 94, 95 and 96 show the terminal reproductive tract of 3 different individuals. The penial appendix extends beyond the length of the penis in 1 specimen, is of moderate size in a second and appears to be somewhat smaller in the third individual. The outer surface of the penial appendix may be irregular with several large "wrinkles" or depressions (Fig. 94) or it may be nearly smooth (Figs. 95, 96). Internally, the penis and penial appendix have numerous folds projecting into the lumen (Fig. 97). The lumen of the penial appendix is continuous with the lumen of the penis (Fig. 97). Pilsbry places *C. vermeta* in the subgenus *Mediappendix* because the penial appendix is attached to the mid-portion of the penis. However, in most populations I have examined, it actually



FIGS. 98–105. *Quickia spurca*. 98, Shell; 99, Jaw; 100, Pigmentation and kidney shape; 101, Ventral view of the reproductive tract; 102, Prostate gland; 103, Terminal male genitalia; 104, Cross-section of the penis; 105, Terminal genitalia-tentacle assembly relationship. Scale lines in mm.

occupies a lower portion along the length of the penis. That is, the length of the penis above the base of the appendix is greater than the length below the base of the appendix. An epiphallus emerges from the top of the penis, continues for a short distance and narrows to become the vas deferens which courses anteriorly underneath the penis (except in 1 case, Fig. 95) to the region of the anterior common genital channel. It then bends posteriorly and passes underneath the spermathecal duct and oviduct until it meets the dorsal surface of the prostate gland. The vas deferens is nearly U-shaped. The penial retractor muscle is very well developed. Its fibers connect to the vas deferens, penis and penial appendix. The attachment on the penial appendix is substantial. The muscle inserts with 2 attachments: (1) In the supporting tissue underneath the left end of the kidney and (2) in the inner surface of the mantle immediately to the left of the kidney just posterior to the first intestinal loop. The relatively long anterior common genital channel opens to the exterior through an expandable slit-like genital aperture.

There are a few differences in this anatomical description and that given by Pilsbry (1948) for *Catinella vermeta:* (1) Pilsbry records only 1 vesicula seminalis [=receptacula seminis] whereas I always find 2 present; (2) he does not record the penial retractor muscle fiber attachment to the penial appendix; and (3) he shows only a short anterior common reproductive channel. In the first case, he probably overlooked the second receptaculum seminis. The differences noted in the second and third cases could be due to population variation or an incomplete description given by Pilsbry.

GENUS *QUICKIA* Odhner

Quickia spurca (Gould)

Shell

Snails used in this study are laboratory reared descendants of specimens collected and sent to me by Dr. William Sodeman. He collected *Quickia spurca* from a damp area of ground immediately around and upon the moist sides of brick foundation pillars of a residence at the Liberian Institute for Tropical Medicine, Harbel, Liberia during October and November, 1968. The shell of *Q. spurca* (Fig. 98) is from 6.5 mm to 8.5 mm in length and 4 mm to 6 mm in width in specimens having 2 1/2 to 3 whorls. The shell is a very pale straw color, delicate, glossy inside but only slightly shiny on the exterior. There is some variation in shell shape from ovate to ovate-attenuate in both field collected and laboratory reared specimens. There is a columellar plait and a thin, untwisted columellar fold. The periphery of the whorls is rounded and the sutures are moderately impressed. The upper peripheral margin of the whorls is slightly depressed in some specimens. The shell is sculptured with closely spaced prominent growth lines, tiny granulaform inclusions (transmitted light) and when the periostracum is removed, the shell has a silvery-white appearance. Most of the field collected specimens I received were encrusted with mud and several showed a definite spiral arrangement of 3 mud ridges on the body whorl. However, on most specimens there did not appear to be such a spiral arrangement of the mud and within a day after the specimens were placed in laboratory culture containers little mud remained on any of the larger specimens. Young specimens (2-3 mm length) reared in the laboratory often show 3 spirally arranged rows of mud on the body whorl, but this condition is never maintained to maturity. The specimens used in this study are comparable to specimens of the type lot of *"Succinea" spurca* Gould (1850) (cat. no. 169378, Museum of Comparative Zoology, Harvard University).

Jaw

The jaw of *Quickia spurca* is shown in Fig. 99. It is a pale amber color with a gold area on the cutting piece. It is higher than wide when measured at the greatest dimensions. The arms of the cutting piece are rounded on the outer edge and have a rounded point which is bent inward at the anterior end of the arms. The anterior margin of the cutting piece is deeply convex with a small median prominence. The posterior margin of the cutting piece is straight. The basal accessory plate is quite thin with oblique sides which slant inward anteriorly. The posterior margin of the basal plate is straight while the corners are gently rounded.

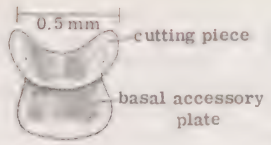
Radula

The radular formula for *Quickia spurca* is 12-14:9-10:1:9-10:12-14. The usual number of marginal teeth is 13 and there are usually 10 lateral teeth. Distinctive radular characters are lacking in *Q. spurca*. Its radula is typically succineid-like in form.

Anatomy

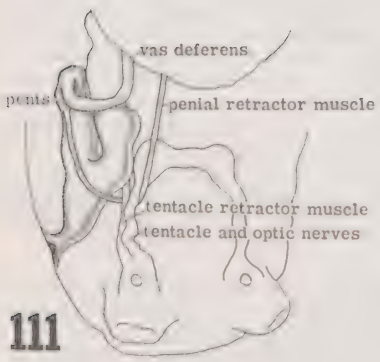
The body of living and preserved animals is rather translucent and appears to be almost colorless except for that color showing through from the internal organs and sparse pigmentation on the mantle in some individuals. The kidney has the shape outlined in Fig. 100 and is pale yellow in color. The black pigment spots on the tentacle assembly (Fig. 105) are readily visible through the body wall. Mantle pigmentation varies from almost none to the maximum amount shown in Fig. 100. Additionally, there is a sparse amount of black pigmentation on the sides of the body wall immediately behind the base of the upper tentacles on most specimens (Fig. 100). The foot of mature, relaxed and fixed animals averages 11-12

106

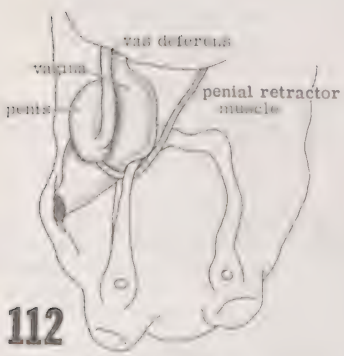


107

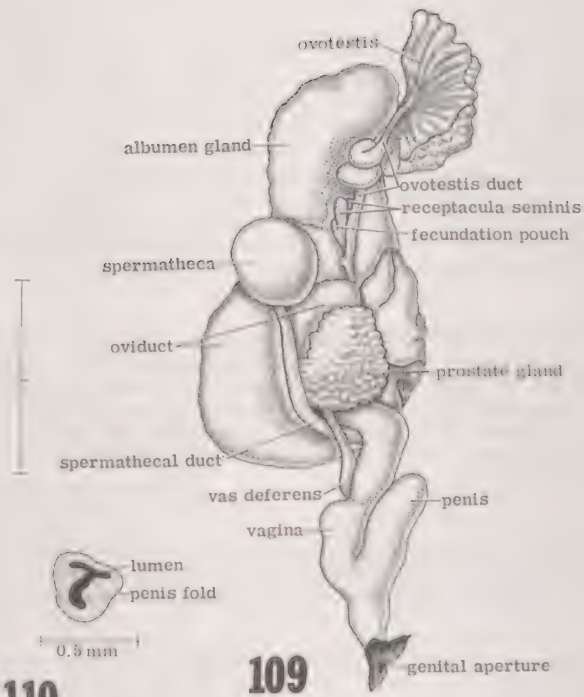
108



111



112



109

110

FIGS. 106-112. *Quickia bensoni*. 106, Shell; 107, Jaw; 108, Pigmentation and kidney shape; 109, Ventral view of the reproductive tract; 110, Cross-section of the penis; 111, Terminal genitalia; 112, Terminal genitalia. Scale lines in mm.

mm in length and 5-6 mm in width.

A ventral view of the reproductive tract of *Quickia spurca* is shown in Fig. 101. The ovotestis, consisting of 50-60 acini, is rather small, dull beige to cream in color, and in some individuals, sparsely pigmented with black granules. The ovotestis duct is nearly straight in some individuals or folded once or twice in others. It is distended in its midsection to form the seminal vesicle. The color of the ovotestis duct is creamy white and it is rather shiny in the seminal vesicle area. Two narrow, almost transparent, white receptacula seminis of unequal size are present. There is a large, saccular, almost transparent white fecundation pouch. The albumen gland is moderately large, elongate-linguiform in shape, solid white in color and follicular in appearance. The tubules forming the albumen gland are almost as large as the acini of the ovotestis. The ducts of the ovotestis, receptacula seminis, fecundation pouch, albumen gland and vas efferens all enter or depart from the upper part of the spermoviduct. The spermoviduct and oviduct have a translucent white color and are compactly folded along their length. Inner folds of the uteral portion of the oviduct are visible externally. The spermatheca is nearly spherical and has a translucent white color. The spermathecal duct emerges from the dorsal surface of the spermatheca. It is long, narrow and white in color. It joins with the oviduct a short distance posterior to the first bend. The vagina is thus long and is twisted 180° between its distal and proximal portions. The wall of the vagina becomes heavier and muscular in appearance anterior to a point opposite the tip of the penis. The external appearance of the prostate gland is that of a rather loose collection of oblong-spheroid bodies that are a bright, opaque white color (Fig. 101). Dissection reveals 5 to 7 bunches of branching tubules (Fig. 102). A varying number of tubules join to form several collecting ducts which empty the secretory products of the prostate into the vas deferens. The vas deferens courses ventrally from the dorsal surface of the prostate gland, then passes dorsally over the vagina, wraps around it to the ventral side of the vagina and inserts at the apex of the penis in close proximity to the penial retractor muscle. The penis is a small simple tube about 1 mm in length and contains prominent inner folds (Fig. 104). The penis is somewhat muscular in appearance. The delicate penial retractor muscle is long and thin. It originates at the apex of the penis adjacent to the vas deferens (Fig. 103), passes posteriorly and inserts in the connective tissue covering the albumen gland and ventral to the kidney. The penial retractor muscle may pass underneath the right tentacle assembly before turning posteriorly (Fig. 105b, c). In other cases it does not pass underneath the tentacle assembly (Fig. 105a). There is some variation in the relative orientation of the penis and vagina as shown in Fig. 105a, b, c. There is also variability in the length of the terminal common reproductive channel. It is most commonly rather long (Fig. 101, 105c), but was short in a few specimens (Fig. 105a) and intermediate in length in several others (Fig. 105b). It is always muscular in appearance and opens to the exterior through an oval genital aperture.

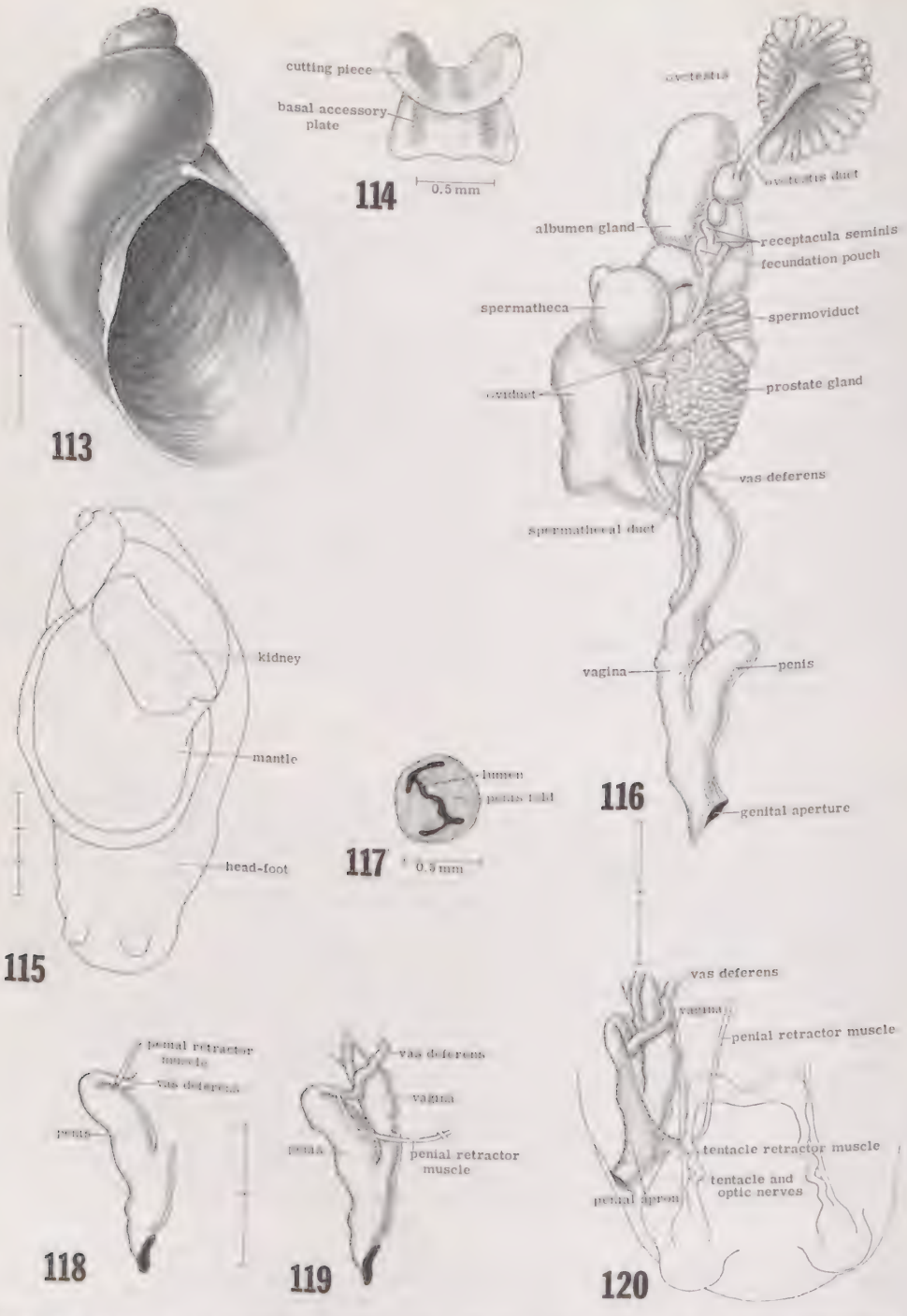
Quickia bensoni (Pfeiffer)

Shell

Specimens of *Quickia bensoni* were obtained from leaf litter on the ground adjacent to and from the stone wall of an empty moat at Fort William, Calcutta, India, in June, 1969. The specimens were found at the same locality Rao (1924) collected them in July, 1923. Shells of adult specimens are generally 8-9 mm high and 5-6 mm wide and have 3 whorls. Many of the live specimens collected were young adults of somewhat smaller size but 1 large adult shell 11 mm high and 6.5 mm wide was found at the collecting site. Shells are ovate (Fig. 106) or ovate-attenuate but the former is most common. In their natural state, the delicate shells of this species are usually covered with a thin layer of mud. This mud was deposited in a spiral arrangement of 3 prominent longitudinal ribs on the body whorl of some of the younger (3-4 mm in length) specimens, while no definite arrangement was discernible on others. The presence of the mud on the shell provided an excellent camouflage, making the specimens difficult to see at first glance. After removing the mud, the shell appears light gray-brown in color, regularly and finely striate in the line of growth with granulaform inclusions and a straight outer lip. There is a moderately distinct columellar plait with a very slight fold. The whorls have a rounded periphery with moderately impressed sutures. Removal of the periostracum renders the shell a translucent silvery-white color. The shell of *"Succinea" bensoni* was described by Pfeiffer (1849) as ovate, conical, narrow, regularly striate, translucent, mud-colored, 3 whorls, penultimate whorl slightly convex, body whorl 2/3 shell length, columella slightly receding, aperture oval, delicate, slightly curved to the right. The shells of specimens used in this study generally fit Pfeiffer's original description for specimens from Moradabad. The more attenuate forms from the Fort William population resemble the illustration for *"Succinea" bensoni* in Hanley & Theobald (1876, pl. 67, fig. 9). Rao (1924) did not give a shell description of the specimens he studied from Fort William.

Jaw

Fig. 107 shows an illustration of the jaw from a young adult *Quickia bensoni* from Fort William. The jaw is nearly the same in height and width when measured at the greatest dimensions. The anterior margin is slightly depressed and without a median prominence. The posterior margin of the basal accessory plate is nearly straight with rounded corners. The jaw is amber with light brown areas on the cutting piece and basal plate.



FIGS. 113–120. *Quickia calcuttensis*. 113, Shell; 114, Jaw; 115, Pigmentation and kidney shape; 116, Ventral view of the reproductive tract; 117, Cross-section of the penis; 118, Terminal male genitalia; 119, Terminal male genitalia; 120, Terminal male and female genitalia-tentacle assembly relationship. Scale lines in mm.

Rao's (1924, fig. 7a) illustration of the jaw of the Fort William *Quickia bensoni* bears little resemblance to the condition I observed. Their only similarity is in the lack of a median prominence. However, Rao states that there may or may not be a median prominence.

Radula

The most common radular formula for *Quickia bensoni* is 14-15:9-10:1:9-10:14-15 in the Fort William population. There is a gradual transition from lateral to marginal teeth. This is due to the fact that the small outer cusp of the lateral does not become suddenly completely divided into 2 cusps. The number of teeth per row varied widely from 37 to 49 in the specimens examined.

Rao (1924) gave the radular formula 4:15:1:15:4 for *Quickia bensoni*. He further stated that "There are never more than five marginals, each having one or two cusps." This statement is not verified by my studies. Furthermore, marginal teeth have as many as 5 distinct cusps, 2 being large.

Anatomy

The bodies of alcohol preserved specimens of *Quickia bensoni* appear translucent white with the internal organs visible, especially anteriorly. The foot of adult specimens measures approximately 11 mm in length and 4.5 mm in width. The kidney has the shape shown in Fig. 108 and is creamy yellow in color. Mantle pigmentation is highly variable. Some specimens are quite extensively pigmented with black while on others the pigmentation is minimal. Fig. 108 shows the maximum pigmentation on the mantle and head-foot region.

Fig. 109 depicts a ventral view of the reproductive tract of *Quickia bensoni*. The ovotestis is relatively large with numerous acini which are closely situated in the organ. The ovotestis is opaque white in color with an occasional black pigment spot on its dorsal surface. The ovotestis duct, which functions as a seminal vesicle in the distended middle portion, is lightly pigmented with black, is of moderate length and is convoluted in its mid-section. Two white receptacula seminis of slightly unequal length are evident. A well developed fecundation pouch is also present. The ducts from the ovotestis, receptacula seminis, fecundation pouch, albumen gland and prostate gland (vas efferens) all open into or depart from the spermoviduct in approximately the same region. The albumen gland is large, white and follicular. It has the usual linguiform shape. The spermoviduct is compactly folded along its length. The prostate gland is of moderate size, follicular in appearance, opaque white in color and sparsely pigmented with black. Although follicular in appearance, its structure consists of bunches of relatively small branching tubules which empty into the vas deferens, which is the usual condition in the Succineidae. The prostate is somewhat flattened. The oviduct is large with the internal folds visible externally along the lower right uteral portion. The walls of the lower oviduct become thicker and are very muscular at the point where the spermathecal duct joins, below which is the highly muscular vagina. The spermatheca is spherical in shape and opaque white in color. Its relatively long duct passes anteriorly and underneath the oviduct and enters it at a level opposite the tip of the penis. Thus, the vagina is quite short in *Q. bensoni*. The vas deferens is large and courses from the dorsal surface of the prostate gland anteriorly to the tip of the penis with a slight turn forming a J-configuration. The penis is approximately equal to the vagina in length, has a thick muscular wall, 2 major folds (Fig. 110), and a T-shaped lumen which is slightly visible externally under high illumination. The penial retractor muscle is long, thin and weak. It originates some distance below the tip of the penis (Fig. 111) and inserts as a minutely thin strand in the connective tissue covering a portion of the digestive tract at a level opposite the mid-portion of the albumen gland (ventral to and distal from the spermatheca when viewing it *in situ*). The penial retractor muscle courses underneath the tentacle retractor muscle and the tentacular and optic nerves (Figs. 111, 112). The anterior common reproductive channel is quite long, has a wide lumen and muscular wall. The penis was bent forward in some specimens (Fig. 112), but it always remained in the same orientation relative to the position of the vagina. The right tentacle assembly always passes on the inner side of the terminal reproductive tract. The genital aperture opens to the exterior as a slit-like passage which is expandable.

SUBGENUS *BURCHELLA* Patterson
Quickia calcuttensis Patterson

Shell

Specimens of *Quickia calcuttensis* were collected from emergent aquatic plants at the edge of Ballygunge Lake, Calcutta, India in June, 1969. The shells of adult specimens have 3 whorls and range in size from 8-9 mm in height and 5-5.5 mm in width. Fig. 113 shows the shell of a young specimen collected in the field and allowed to mature in the laboratory. In their natural condition, the snails live on aquatic vegetation. The shell is generally covered with a film of water thereby appearing very shiny and translucent. The internal organs such as the kidney, heart and digestive gland are easily visible through the shell. Upon removal of the animal, the shell appears a pale yellowish-buff in the region of the spire, and it becomes paler in the area of the body whorl until it is a translucent cream color at the apertural margin. A slight columellar fold is evident on the apertural margin of the columellar plait. This species is am-

phibious and does not deposit mud on its shell. The shell is regularly and finely striate in the line of growth and lacks granulaform inclusions. Variation in shell shape is minimal. The whorls are rounded and the sutures moderately impressed.

Jaw

The chitinous jaw of *Quickia calcuttensis* is slightly higher than wide when measured at the greatest dimensions (Fig. 114). It is amber in color with gold areas on the cutting piece and basal accessory plate. The anterior margin of the cutting piece is depressed with a well-developed median prominence. The cutting piece is substantially strong and its arms are wide and rounded. The sides of the basal accessory plate are oblique inward and its posterior margin is wavy in outline.

Radula

The approximate radular formula for *Quickia calcuttensis* is 18:12:1:12:18. However, there was a variation from 55 to 61 teeth per row. The transition from lateral to marginal teeth is gradual. Marginal teeth have as many as 5 cusps with 2 of them large.

Anatomy

The bodies of living and alcohol preserved specimens of *Quickia calcuttensis* are slightly yellowish-translucent-cream color, with the internal organs visible through the body wall. The kidney is light yellow posteriorly and becomes a light cream color at the anterior urethral margin. The kidney is somewhat bilobed on the left end (Fig. 115). As in most succineids, the amount and pattern of mantle pigmentation is variable among the different individuals. The black pigmentation markings on the mantle and head-foot region of a specimen with the maximum pigmentation found is shown in Fig. 115. There is some pigmentation around the pulmonary opening.

Fig. 116 illustrates the ventral view of the reproductive tract of *Quickia calcuttensis*. The ovotestis is of moderate size with large tubular acini clearly visible. The ovotestis is yellowish-creamy-white in color. The ovotestis duct is greatly distended and convoluted in its mid-section which serves as the seminal vesicle. It is narrow at each end and has a shiny white color. Two yellow-orange receptacula seminis of subequal length and a well developed fecundation pouch are clearly evident. Opening into or departing from the spermoviduct are the ducts of the ovotestis, receptacula seminis, fecundation pouch, albumen gland and vas efferens which leads to the prostate gland. The albumen gland is the same yellowish-creamy-white color as the ovotestis. It is follicular in appearance and linguiform in shape. The spermoviduct is compactly folded and translucent white in color. The prostate gland is white with very sparse black pigmentation. The tubules of the flattened prostate gland are similar in size and appearance to those of *Q. bensoni*, but somewhat less compactly organized. The oviduct is large with the internal folds of the lower right uteral section visible externally. Anterior to that point, the thick wall of the lower oviduct becomes more muscular so that interior folds are not visible externally. The vagina is thick-walled, highly muscular and short. The spermatheca is also an opaque yellowish-creamy-white in color and spherical in shape. Its duct courses anteriorly dorsal to the lower oviduct and joins with it at a level opposite the tip of the penis. The vas deferens is longer than in *Q. bensoni*, but it extends from the prostate gland to the tip of the penis in a similar J-configuration. The penis is sheathless and highly muscular with prominent inner folds (Fig. 117). The penis is slightly longer than the vagina, and its tip is lightly colored with a dull orange pigment. In *Q. calcuttensis*, the penial retractor muscle attaches on the vas deferens with fine strands extending to the penis proper (Fig. 118). A thin connective tissue and the retractor muscle strands hold the vas deferens closely appressed to the penis from its point of origin at the penis tip to a point where the vas deferens bends posteriorly toward the prostate gland (Fig. 119). The penial retractor muscle is long, thin and delicate. It passes from the penis underneath the tentacle retractor muscle (in ventral view) and the tentacular and optic nerves. The penial retractor muscle inserts in the thin connective tissue covering the spermoviduct on the left side at a level adjacent to the anterior part of the albumen gland. A distinctive character of the subgenus *Burchella* of which *Q. calcuttensis* is the type species, is the presence of a well developed tissue sheet which covers the dorsal portion of the penis and part of the anterior common reproductive channel (Fig. 120). This structure is named the penial apron. The upper border of the penial apron is bounded by the penial retractor muscle. The penial nerve innervates the penial apron and, in fact, the tissue of the apron is firmly attached to the penial nerve close to its origin at the brain. The broad attachment of the penial apron is along the outer side of the penis. In *Q. calcuttensis*, the penial apron is very well developed as a rather thick tissue sheet which does contain muscle cells. It is colored with a dull orange pigment. The anterior common reproductive channel is nearly equal in length to the penis and vagina. Its thick walls are highly muscular and open to the exterior through an expandable slit-like genital aperture.

CYTOTAXONOMIC STUDIES

There have been a number of studies specifically intended to elucidate chromosome numbers of mollusks. In addition to papers on cytotaxonomy, incidental reports of chromosome numbers have been included in studies on hybridity, polyploidy, sex determination, parthenogenicity, supernumerary chromosomes, karyotype analyses and medical zoology. Chromosome numbers are known for less than 0.5% of the species of recent mollusks.

Studies on chromosomes of mollusks date from the late 1800's, but due to inferior optical equipment and methods, many of the very early reports were inaccurate. With improved microscopes and the advent of the squash technique for chromosome preparations, accurate chromosome number determinations can now be made.

Perrot (1938) and Husted & Burch (1946) were the first to conduct cytotaxonomic studies on groups of land snails. Husted & Burch pointed out the conservativeness in regard to chromosome number change in the Polygyridae and noted that members of the genus which were considered most primitive had the lowest haploid chromosome numbers. Burch (1965) reviewed chromosome numbers and systematics in euthyneuran snails and pointed out that "The more advanced groups among the Euthyneura, or those often considered more specialized, also have the greater number of chromosomes. Since it has been shown that in most groups the chromosome numbers are quite stable, it becomes possible to indicate the relative degree of specialization in groups in which there are even slight but constant changes in chromosome numbers. When these criteria are applied specifically to groups, chromosome numbers will in part confirm previous views on phylogeny, but in part necessitate re-evaluation of those characters on which certain of the phylogenetic schemes are based." A. Inaba working in Japan and J. B. Burch in the United States are mainly responsible for our current concepts of cytotaxonomy of the Mollusca.

The Succineidae are especially interesting cytologically because of the wide variation in chromosome numbers among the species (Burch, Patterson & Natarajan, 1966; Natarajan, Hubricht & Burch, 1966) and because the lowest haploid numbers known in the Mollusca occur in several species placed in the subfamily Catinellinae (Burch, 1964a, b; Patterson & Burch, 1966). Prior to this study and based on available information on chromosome numbers, the subfamilies Catinellinae and Succineinae appeared to be cytologically distinct; haploid chromosome numbers n=5 and n=6 characterized species belonging to the Catinellinae while 11 or more pairs of chromosomes were found among Succineinae species. Thus, it seemed worthwhile to extend the studies on cytotaxonomy of the Succineinae to determine if such a distinction remained the case and if, indeed, chromosome numbers gave any indication of phylogenetic relationships within the family.

Succineids are hermaphroditic land pulmonates. Thus, one can expect to observe both ŏogenesis and spermatogenesis simultaneously in the same ovotestis. Both are observed, but chromosome numbers are determined almost always from cells in spermatogenesis which are numerous. There are relatively few cells in ŏogenesis at any one time or perhaps meiosis is not completed until after the egg is laid as in the Basommatophora. Furthermore, there is a large amount of egg cell cytoplasm which usually seems to prevent good chromosome spreading. With regard to spermatogenesis, many more cells of adults are usually observed in meiotic division stages than in mitotic divisions. This can possibly be due to one or more of the following considerations: (1) In temperate climates, spermatogonial mitoses seem to occur in the greatest number in the early spring for a short

period of time at the beginning of the reproductive phase; (2) in laboratory reared individuals, spermatogonial mitoses appear to begin in very young (10-14 days) individuals, but whether most mitotic divisions are completed at a very young age has not yet been determined; (3) a few mitotic cells are occasionally seen in adult snail's ovotestes chromosome squash preparations but whether the low frequency is due to fewer divisions or shorter division time is not known. Due to the infrequency of mitotic divisions and the rarity of locating a cell where all the chromosomes are well spread apart and where all the centromeres can be discerned, karyotypes are difficult to determine. Only chromsome numbers are reported from the results of this study since karyotypes were not determined for enough species in any 1 genus to be of cytotaxonomic value.

Table 1 shows the haploid chromosome numbers currently known for members of the Succineidae. They range from n=5 to n=25 among the 45 species studied.

Information is available for species belonging to both genera (*Catinella* and *Quickia*) currently assigned to the subfamily Catinellinae. Nine species of *Catinella* have 5 or 6 pairs of chromosomes. *C. putamen* from Samoa has 5 pairs of chromosomes (Fig. 124). *C. rotundata*, also having the chromosome number n=5, is the only other Pacific *Catinella* studied cytologically. The 2 forms are rather distinct cytologically, because in *C. rotundata* 1 cross-shaped and 4 circle-shaped bivalents are most commonly observed in diakinesis (Burch, 1964a), whereas in *C. putamen*, 1 circle-shaped and 4 cross-shaped bivalents are most prevalent during that meiotic stage. Haploid chromosome numbers were determined for 2 *Catinella* species from the U.S.A. and an unidentified species from Mexico. All had 6 pairs of chromosomes. No distinctive cytological features were seen in *C. aprica* (Fig. 125) or *C.* sp. from New Mexico. The diakinetic chromosomes of *C. aprica* and *C.* sp. from New Mexico resemble those of *C.* cf. *gabbi* (see Burch, Patterson & Natarajan, 1966) and *C. texana* (see Natarajan, Hubricht & Burch, 1966) in 2 respects : (1) All have 6 cross-shaped bivalents and (2) 1 of the bivalents is conspicuously larger than the others of the complement. However, the *Catinella* population from Mexico was rather unique because all meiotic diakinesis and Metaphase I cells had 2 small supernumerary chromosomes present (Fig. 123). The behavior of these extra chromosomes was not followed through the chromosome cycle. The original collection received from Mexico apparently contained both *Catinella* and *Succinea* species. The *Catinella* died out almost immediately, but *Succinea* flourished for 11 generations in laboratory culture. Anatomically, the *Catinella* from Mexico is distinct from *C. texana* and resembles *C. vermeta* rather closely. *C.* sp. from New Mexico is probably closely related to the population from Mexico and is also distinct from *C. texana*. *C. vermeta* differs from all of the other North American *Catinella* species in regard to chiasma frequency; it most commonly has 6 ring-shaped bivalents (2 chiasmata each) (Burch, 1964b; Patterson & Burch, 1966). In the European *C. arenaria*, there are usually 3 or 4 rings while the remaining bivalents are rod or cross-shaped (1 chiasmata) (Butot & Kiauta, 1967).

The chromosome numbers of 5 species of *Quickia* were determined in this study. Two species from the African fauna (*Q. spurca* from Liberia, Fig. 129 and *Q.* sp. from Aldabra, Fig. 128) and 3 species from India (*Q. bensoni*, Fig. 130; *Q. calcuttensis*, Fig. 126; *Q.* cf. *gravelyi*, Fig. 127) all have 25 pairs of chromosomes. There were no readily apparent distinctive cytological characters among the species, but only meiotic chromosomes were examined.

The haploid chromosome numbers determined to date for members of the subfamily Catinellinae are n=5, n=6 and n=25. There is no evidence as yet to support

TABLE 1. Haploid chromosome numbers in the family Succineidae

Species	Haploid No.	Source	Reference
Subfamily CATINELLINAE			
Genus *Catinella*			
Subgenus *Catinella* s.s.			
Catinella putamen	5	Upolu I., Samoa	This study
C. rotundata	5	Oahu I., Hawaii+	Burch, 1964a
Subgenus *Quickella*			
Catinella arenaria	6	England	Butot & Kiauta, 1967
C. vermeta	6	U.S.A.+	Burch, 1964b; Patterson & Burch, 1966
C. texana	6	U.S.A.+	Natarajan, Hubricht & Burch, 1966
C. cf. *gabbi*	6	U.S.A.	Burch, Patterson & Natarajan, 1966
C. aprica	6	U.S.A.	This study
C. sp.	6+2	Mexico	This study
C. sp.	6	U.S.A.	This study
Genus *Quickia*			
Subgenus *Quickia* s.s.			
Quickia spurca	25	Liberia	This study
Quickia aldabraensis	25	Aldabra	This study
Q. bensoni	25	India	This study
Subgenus *Burchella*			
Quickia calcuttensis	25	India	This study
Q. cf. *gravelyi*	25	India	This study
Subfamily SUCCINEINAE			
Genus *Succinea*			
Subgenus *Succinea* s.s.			
Succinea sp.	11	Tanzania	This study
S. oblonga	11, 12	Europe	Rainer, 1967; Butot & Kiauta, 1967
S. girata	17	Curacao	Kiauta & Butot, (pers. comm.)
S. concordialis	18	U.S.A.+	Natarajan, Hubricht & Burch, 1966
S. sanibelensis	18	U.S.A.	This study
S. greeri	18	U.S.A.+	Natarajan, Hubricht & Burch, 1966
S. campestris	18	U.S.A.+	Burch, Patterson & Natarajan, 1966
S. urbana	18	U.S.A.+	Natarajan, Hubricht & Burch, 1966
S. luteola	18	U.S.A.+	Natarajan, Hubricht & Burch, 1966
S. cf. *stretchiana*	18	U.S.A.	This study
S. sp.	18	U.S.A. (Texas)	This study
S. sp.	18	U.S.A. (N. Mex.)	This study
S. kuntziana	18	Éfate I., New Hebrides	This study
S. strubelli	18	Papua	This study
S. grosvenori	19	U.S.A.	Natarajan, Hubricht & Burch, 1966

TABLE 1. (cont.)

S. ovalis	21	U.S.A. +	Husted & Burch, 1946; Burch, Patterson & Natarajan, 1966
S. putris	22	Europe+	Perrot, 1938; Butot & Kiauta, 1964
S. lauta	22	Japan+	Burch, 1965
S. l. sphaerica	22	Japan	Burch, 1965
Genus *Neosuccinea*			
Neosuccinea sp.	17	Japan+	Burch, 1965*
Genus *Oxyloma*			
Subgenus *Oxyloma* s.s.			
Oxyloma japonica	15	Japan+	Burch, 1965
O. hirasei	17	Japan	Koyama, 1955
O. kwansae	17	Japan	Koyama, 1955
O. sarsi	17	Europe	Butot & Kiauta, 1964
O. cleopatrae	18	Egypt	This study
Subgenus *Neoxyloma*			
Oxyloma haydeni	19	U.S.A.	Franzen, 1966
O. retusa	19	U.S.A. +	Natarajan, Hubricht & Burch, 1966
O. salleana	19	U.S.A. +	Burch, Patterson & Natarajan, 1966
Genus *Omalonyx*			
Subgenus *Omalonyx* s.s.			
Omalonyx felina	21	Antigua	This study
Genus *Lithotis*			
Lithotis rupicola	24	India	This study
Genus *Indosuccinea*			
Indosuccinea khandalla	24	India	This study

+ denotes confirmation during this study

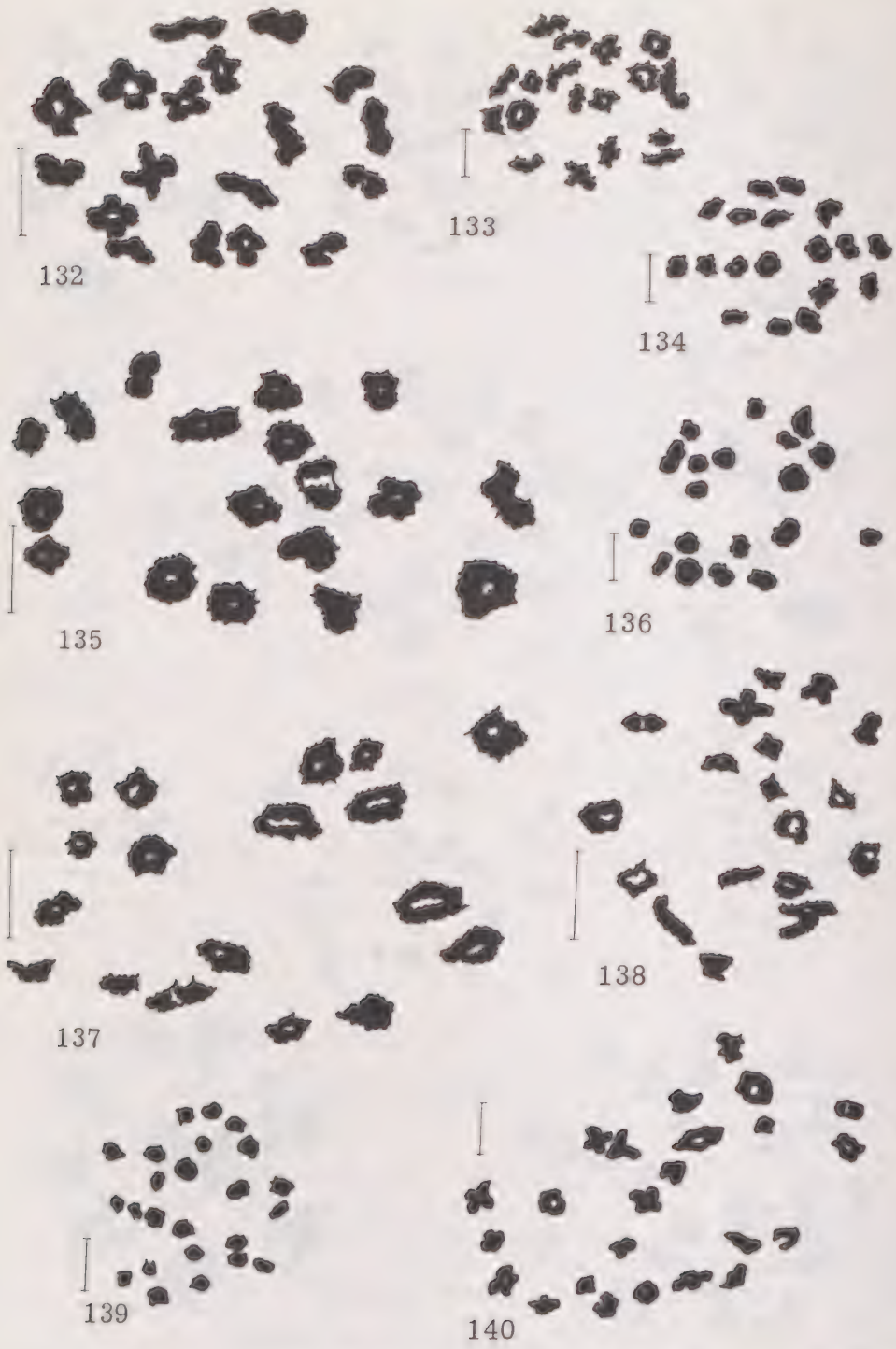
* Shown as *S. horticola* in Burch, 1965.

polyploid origins for the higher chromosome number.

Haploid chromosome numbers range from n=11 to n=24 among the 31 members of the subfamily Succineinae studied cytologically. Chromosome numbers are reported for the first time for members of the aberrant genera *Omalonyx*, *Indosuccinea* and *Lithotis*.

Members of the genus *Succinea* have chromosome numbers that range from n=11 to n=22. An unidentified *Succinea* from Tanzania had only 11 pairs of chromosomes. The European *S. oblonga* is the only other member of the genus to have such a low chromosome number. Rainer (1967) examined 2 specimens of 1 population of *S. oblonga* and found predominantly n=11 in 1 specimen and a variation in the other of n=10-12, with n=12 predominant. He concluded that n=11 is probably the normal haploid chromosome number of *S. oblonga* and that a connection to *S. putris* (n=22) through polyploidy was conceivable. However, the data do not support a polyploid origin since there are species with intermediate

FIGS. 121–131. Meiotic chromosomes. 121, *Omalonyx felina*; 122, *Oxyloma cleopatrae*; 123, *Catinella* sp. (Mexico); 124, *Catinella putamen*; 125, *Catinella aprica*; 126, *Quickia calcuttensis*; 127, *Quickia* cf. *gravelyi*; 128, *Quickia* sp. (Aldabra); 129, *Quickia spurca*; 130, *Quickia bensoni*; 131, *Succinea* sp. (Tanzania). Scale lines = 5 micra.



FIGS. 132–140. Meiotic chromosomes. 132, *Succinea* cf. *stretchiana*; 133, *Succinea* sp. (Texas); 134, *Succinea concordialis*; 135, *Succinea sanibelensis*; 136, *Succinea* sp. (New Mexico); 137, *Succinea kuntziana*; 138, *Succinea strubelli*; 139, *Lithotis rupicola*; *Indosuccinea khandalla*. Scale lines = 5 micra.

numbers of n=17, 18, 19 and 21 in the genus *Succinea*. Such a progressive increase in chromosome numbers could more likely be explained through aneuploidy. Also, morphologically and anatomically, *S. oblonga* and *S. putris* are somewhat different. Kiauta & Butot (1968) examined 15 specimens from various localities and found all *S. oblonga* to have 12 pairs of chromosomes. Such a variation in chromosome number as reported by Rainer has not been found in any other *Succinea* and is an interesting observation.

Succinea sanibelensis from the southern U.S.A. was found to have a haploid chromosome number of n=18 (Fig. 135), the same number reported for *S. concordialis*, *S. greeri*, *S. urbana*, *S. luteola* (see Natarajan, Hubricht & Burch, 1966) and *S. campestris* (see Burch, Patterson & Natarajan, 1966), which are also from the southern United States.

Since there have been some mis-identifications of *Succinea concordialis*, the meiotic chromosomes of an individual from a topotype population from Lake Concordia, Louisiana, are recorded in Fig. 134.

Succinea cf. *stretchiana* from California also has 18 pairs of chromosomes (Fig. 132) and is the only Western North American *Succinea* which has been studied cytologically.

Two unidentified *Succinea* populations, 1 from Texas and the other from New Mexico, both have 18 bivalents in the first meiotic division (Figs. 133, 136). These were included in Table 1 merely to show the conservativeness of most North American *Succinea* in regard to chromosomal number change. *S. grosvenori* (n=19) is the only U.S.A. species other than *S. ovalis* (n=21) to have more than 18 bivalents.

Two Pacific species, *Succinea kuntziana* from the New Hebrides and *S. strubelli* from Papua, were also found to have 18 pairs of chromosomes (Figs. 137, 138). No other Polynesian or Melanesian *Succinea* have been studied cytologically.

Haploid chromosome numbers among members of the genus *Oxyloma* range from n=15 to n=19 in the 8 species studied. *O. cleopatrae* from Egypt has a haploid chromosome number of n=18 (Fig. 122). This is the only African *Oxyloma* studied cytologically and the only species to have the haploid number n=18. All 3 North American *Oxyloma* species studied cytologically have 19 pairs of chromosomes. *O. japonica* is especially interesting cytologically since it has only 15 meiotic bivalents, whereas the other 2 Japanese *Oxyloma* species have the chromosome number n=17.

Omalonyx felina, the first representative of this genus studied cytologically, has 21 pairs of chromosomes (Fig. 121). The meiotic diakinetic chromosome complement of *O. felina* is rather distinctive in having 4 conspicuously large bivalents which almost always seem to be in close association on 1 side of the cell.

Litholis rupicola, the only member of this aberrant genus studied cytologically, has the haploid chromosome number n=24 (Fig. 139).

Twenty-four pairs of chromosomes were also seen in *Indosuccinea khandalla* (Fig. 140).

DISCUSSION

PHYLOGENETIC POSITION OF THE SUCCINEIDAE

The family Succineidae has traditionally been placed by most molluscan systematists in the Stylommatophora, the gastropod order containing the majority of land snails. The Succineidae, along with the smaller families Ailliidae and Athoracophoridae, are included in Pilsbry's (1900) suborder Heterurethra, named for the heterurethrous pallial complex. The Succineidae, although basic-

ally stylommatophoran in morphology, is an especially interesting family because its species have various morphological features which are possessed also by members of the predominantly freshwater order Basommatophora and some marine opisthobranchiate mollusks. Rigby (1965) stated that "...The family Succineidae has usually been placed at the base of the Stylommatophora but its members differ from stylommatophorans and resemble basommatophorans in the following features, pointed out by Dr. H. E. Quick (personal communication): the tentacles have broader bases, the prostate is discrete, a posterior gastric caecum occurs, many egg capsules are bound together in the spawn which is deposited and no caudal vesicle is visible during the embryonic period." Rigby also pointed out that the Succineidae (*Succinea putris*) has morphological affinities with the aplysiomorph tectibranchs in regard to the following features of the alimentary system: "(1) the post-oesophagus is distended and used for initial breakdown of food either as a crop or as crop plus gizzard, (2) the stomach is reduced and portions linking with the digestive gland are separated by sphincter muscles from the axial tract of the stomach, (3) a posterior excretory caecum which carries both typhlosoles (*Aplysia*) or probably only the minor typhlosole (*Succinea*) arises from the style sac region of the stomach." Although a posterior excretory caecum occurs in the higher limnic Basommatophora, Rigby contends that evolutionary trends have been different in the Basommatophora and Succineidae. Concerning reproductive features, Rigby cited the following similarities between succineids (*S. putris*) and opisthobranchs. The pallial reproductive tract is divided into 3 channels: (1) the vas deferens for departing sperm, (2) the mucous gland (=oviduct), vagina and vestibule for departing spawn and (3) the ciliated groove of the posterior vagina and oviduct which is the course taken by allosperm received during copulation. There is a discrete prostate gland in *Succinea* which is in agreement with the form of the same gland in opisthobranchs. A short duct separates the albumen gland from the main reproductive tract in *Succinea* which is similar to the condition in opisthobranchs. The receptaculum complex and penis of Stylommatophora exhibits affinities with the Opisthobranchia and "...suggest that these two groups show a different evolution from the Basommatophora" (Rigby, 1965). Limited similarities between *Succinea* and Basommatophora were admitted by Rigby to be present in (1) a differentiation of the anterior female reproductive tract and deposition of gelatinous egg masses, (2) the receptaculum complex and (3) possession of a posterior gastric caecum in higher Basommatophora. She stated that the lines of evolution of penes in *Succinea* and Basommatophora are different. Furthermore, Rigby contends that the Succineidae differ from other Stylommatophora in the following features: (1) "In the Stylommatophora...the pallial reproductive tract is for the most part undivided, and the outgoing sperm, eggs and sperm received in copulation all pass along the same channel, the lumen of the mucous gland..."; (2) a posterior excretory caecum is not mentioned to be present in the Stylommatophora; (3) "...the prostate of Stylommatophora is diffuse..."; (4) eggs are laid singly in Stylommatophora but are deposited in gelatinous masses in Succineidae. Rigby concluded that "...this review of reproductive systems among the Opisthobranchia, Stylommatophora and the Basommatophora leads to conclusions similar to those reached by study of their alimentary systems, viz.; (1) that the Succineidae should be placed among the tectibranch opisthobranchs; (2) that the Stylommatophora share many features with the opisthobranchs; and (3) that these two groups have evolved from a common prosobranch stock. Certain characters suggest that the Basommatophora have arisen from a related group of prosobranchs but that they have since evolved independently of the Stylommatophora and Opisthobranchia".

Several comments are pertinent with regard to the preceding statements concerning relationships of the Succineidae to other Stylommatophora, and to the Basommatophora and Opisthobranchia. Although the tentacle bases are broad in both the Succineidae and Basommatophora (as pointed out by Quick to Rigby), this superficial character does not indicate a valid relationship between the 2 taxa since their tentacles exhibit fundamental differences both structurally and functionally. Furthermore, the tentacles of succineids are more like those of other Stylommatophora than any other taxonomic group (order) in the following features: (1) there are 2 pairs (except in *Lithotis* and perhaps *Neohyalimax*); (2) they are introvertible and not solely contractile; (3) eyes are borne at the tips of the dorsal pair instead of at the tentacle bases and (4) the tentacular retractor muscle and the tentacular and optic nerves pass through hollow tubes of the dorsal tentacle pair. Broadened tentacle bases of Succineidae are reminiscent of the same condition occurring in the Athoracophoridae and probably among some Orthurethra. A discrete prostate gland occurs not only in the Opisthobranchia but also in the Basommatophora and in many stylommatophoran groups as well, (e.g., Achatinellidae and Tornatellinidae). Also, according to Solem (1969) "...completely separated prostate and uterine oviducal tubes are in the Endodontinae and many other taxa...". Division of the pallial reproductive tract into 3 functionally distinct channels also occurs in the Basommatophora (i.e., *Stagnicola emarginata*) and perhaps in some orthurethran stylommatophorans. It is true that most succineids lay eggs which appear to be contained in gelatinous masses. However, *Succinea ovalis* often deposits solitary eggs which, because of their outer gelatinous layers, *may* adhere together, but they are not contained in a single gelatinous mass. The eggs of *Omalonyx felina* are often laid in a configuration resembling a string of beads. This condition is strikingly similar to the egg string of the soleoliferan slug, *Veronicella*. Furthermore, although some succineid species lay eggs which may appear as contained in a gelatinous mass, the condition is basically different than that occurring in the Basommatophora. Most basommatophoran eggs are laid as a mass within a common "capsule", which is composed of several distinct layers. Each egg of most succineids has a rather "watery", thick, outer gelatinous layer which causes it to stick to other eggs to form a "mass". But the egg mass so formed does not have a common envelope. An egg can be easily removed without damaging the "mass", whereas the outer capsule must be ruptured before an egg can be removed from a basommatophoran egg mass. Thus, the resemblance between egg masses of succineids and basommatophorans is only superficial. It does not seem that the Succineidae share only with opisthobranchs a sufficient number of characters to warrant removing them from the Stylommatophora and placing them with the Opisthobranchia as Rigby (1965) recommends.

Cook (1966) studied the morphology and histology of the central nervous system (CNS) of *Succinea putris* and compared it with the conditions found in the CNS of various opisthobranchs, basommatophorans and stylommatophorans. He concluded that "(1) *S. putris* possesses a CNS which is typically stylommatophoran in most respects. (2) Some characteristics of the CNS resemble those of Basommatophora. (3) Reclassification of *S. putris* as a basommatophoran or an opisthobranch on the basis of the morphology of the CNS, is not warranted."

The cerebral ganglia of pulmonates was studied by Van Mol (1967) in regard to both morphology and function. He found the cerebral ganglia of 3 succineids (*Succinea putris*, *Oxyloma sarsi* and *Omalonyx unguis*) to have the most primitive organization found among the Stylommatophora and stated "...Chez les stylommatophores, il subsiste peu de doutes sur la position exacte des Succineidae: ce

sont les formes les plus primitives. Leurs affinitiés avec les Athoracophoridae ont été confirmees. Ces deux familles ont été réunies dans le Sous-ordre des Elasmognatha. Les Orthurethra occupent incontestablement une position plus élévee dans l'échelle systématique, les Sigmurethra viennent en dernier lieu." Van Mol believes the Elasmognatha (=Heterurethra) were derived from an archeopulmonate ancestor.

Butot & Kiauta (1967) presented a discussion on the systematic position of the Succineidae. They restated the conclusions of Rigby (1965) and Cook (1966) and add 2 additional considerations, (1) that the pulmonate Onchidiidae, Rathousiidae and Veronicellidae which have eyes at the tips of dorsal tentacles have been removed by some systematists from the Stylommatophora and placed in the order Soleolifera, and (2) in regard to the elasmognathous jaw, the Succineidae show "...an homogenity which prevents any phylogenetical relationship to the remainder of the Stylommatophora," Therefore, they conclude that"...the Heterurethra should be removed from Stylommatophora forming a separate order under the name Succineoidea. The older names Elasmognatha and Heterurethra for this group are rejected as we prefer to follow Taylor & Sohl (1962)."[4] However, the Onchidiidae, Rathousiidae and Veronicellidae were placed in the order Soleolifera because they differ fundamentally from the Basommatophora and Stylommatophora in regard to many morphological characters (i.e., position of the anus, lung, breathing pore and nephridial opening, and keeled integument, to name a few). Burch (1969) stated that the tentacles "... of the Veronicellidae, although having eyes at their tips, are in other respects quite different from those of the Stylommatophora." Van Mol (1967) commented that "Chez les Soleoliferes, l'ensemble du tentacle et du Procerebrum s'est specialise dans le meme direction que chez les Stylommatophores. Cette realization, correlative a un mode de vie identique, differe dans le detail de son organisation; il s'agit donc ici d'une convergence." More important though is that the tentacles of Succineidae are quite typically stylommatophoran, as are most succineid morphological characters. In regard to the jaw of Succineidae, it basically resembles that of other Stylommatophora, except for the presence of a basal accessory plate, which is also found in the Athoracophoridae. The basal accessory plate is an interesting modification of the jaw but according to Burch (1969) "...is hardly a character to be used to separate ordinal taxa. The jaws of some other land snails are just as different when compared to the majority of the Stylommatophora." The basal accessory plate of the jaw "...does not indicate a separate origin for the Succineidae." Thus, all evidence seems to indicate that the Succineidae, although perhaps primitive, are truly heterurethrous stylommatophoran land snails; the practice of placing the family in another suborder, order or with the Opisthobranchia is not warranted.

Baker (1955) in analyzing and reviewing morphological characteristics of land snails concluded that "...the ancestors of the Sigmurethra[5] probably had an aulacopod foot and a heterurethrous lung...". Both of these characters are found in

---

[4]Two points must be made concerning this last statement by Butot & Kiauta: (1) according to the recommendations of the International Code of Zoological Nomenclature, -oidea is an ending used to designate a superfamily and hence is used incorrectly in the designation of their order Succineoidea, and (2) Taylor & Sohl (1962) used the suborder Heterurethra which included the families Succineidae, Aillyidae, and Athoracophoridae. The use of Succineoidea to designate the order is not recommended.

[5]The majority of land snail families are included in the Sigmurethra.

the Succineidae. Thus, it seems appropriate to discuss the relationships of Succineidae to other Stylommatophora in regard to several characters which have not been closely analyzed by systematists.

In the Stylommatophora, the extended eye bearing tentacle is an elongate hollow structure with an eye at its tip. In regard to retraction type, it is inversible (or introvertible). In addition to inverting, the tentacles of non-athoracophorid species can be partially withdrawn by contraction, but complete withdrawal of the tentacle cannot be accomplished without inversion. In all non-athoracophorid species, inversion can be initiated at any stage during contraction. The tentacles of some species become thicker as contraction progresses, but in others there is little or no noticeable thickening of the tentacle. In all groups, except Succineidae and Athoracophoridae, the tentacles are covered with a rugose dermis which is a continuation of the skin pattern of the dorsal head-foot and extends distally to the base of the bulbous tip which bears the eye. Tentacle retraction in the Succineidae, although basically similar to the foregoing description, can be seen to have certain similarities to the athoracophorid, *Aneitea*. The rugose pattern abruptly ceases and the remaining 1/2 of the tentacle is smooth. The proximal tentacle tapers noticeably to the junction between the proximal rugose 1/2 and the distal smooth 1/2. From this point the distal 1/2 continues in an untapered rod-like fashion to the terminal optic bulb. The tentacles can be contracted as in other non-athoracophorid Stylommatophora, i.e., on direct stimulation, the tip of the distal 1/2 of the tentacle can be inverted at any position. But, during non-inversible withdrawal, most of the initial contraction is accomplished by the tapering rugose basal 1/2. On continued non-inversible retraction the distal smooth rod-like portion seems to partially slide into the proximal part, reminiscent of *Aneitea* (see Burch & Patterson, 1969), although the terminal 1/2 of the tentacle cannot quite completely retract into the basal 1/2 before it is necessary to invert. Therefore, the tentacles of Succineidae seem to be intermediate between the tracheopulmonate slugs on the one hand and to the remaining Stylommatophora on the other, and hence, in this respect, the Succineidae would seem to be an ideal ancestral type to both groups.

The features of the pedal grooves of Succineidae also deserve mention. The Succineidae are aulacopod with the distinctness of the grooves varying among the representatives. Generally, the lower pedal groove is readily distinguishable, but is not deeply impressed. The upper pedal groove (often called the supra-pedal groove) is moderately distinguishable to nearly indistinguishable. Seemingly, the Succineidae would be an ideal type from which to derive the holopod condition on the one hand and the more distinctly aulacopod foot on the other.

The body surface pattern of Succineidae appears to be intermediate between the condition seen in the Athoracophoridae and that characteristic of the other Stylommatophora. The athoracophorid slugs have a series of widely spaced, prominent, diagonally impressed lines along the sides of the body and foot. The body surface does not show a rugose epidermal sculpture. Among other Stylommatophora (excluding Succineidae) a rugose epidermal surface sculpture is present, but widely spaced impressed lines of the nature of those found in the Athoracophoridae are absent. Most Succineidae possess some weakly impressed, distinct, widely spaced diagonal lines along the side of the body and foot which is reminiscent of the athoracophorid condition. These lines are more noticeable in some species, especially those having a pigmented body and foot, where the lines are without pigmentation. Succineids also possess a rugose pattern of epidermal body sculpture similar to that of the other Stylommatophora excluding the Athoracophoridae.

The relatively simple structure of the reproductive system of Succineidae also appears to be an ideal ancestral type. Thus, it does not seem unreasonable to postulate that certain specialized structures in the athoracophorid slugs and the other Stylommatophora could have been derived from less specialized ones in the Succineidae. Van Mol (1967) also expressed the opinion, based on features of the cerebral ganglia, that the family Succineidae is the most primitive land snail group.

ZOOGEOGRAPHY

The following is an account of the distribution of genera of Succineidae based on information in the literature and additional data assembled during this study.

Succinea

Species belonging to the genus *Succinea* are the most widely distributed group and are represented throughout most geographical areas of the earth. Available records indicate that members of *Succinea* have been collected from the following geographical areas: Arctic areas, North, Central and South America, the Caribbean islands, British Isles, Europe (including Scandanavia), Asia (including the Soviet Union, China, India, Burma, Southeast Asia, the Malay peninsula and Japan), south Atlantic Ocean Islands, Africa and its off-shore islands, New Zealand, Australia and various islands in Melanesia (including New Guinea) and Polynesia.

Oxyloma

The distribution of *Oxyloma* is somewhat more limited than that of *Succinea*. Distributional data is quite incomplete due to the fact that many *Oxyloma* species have been called *"Succinea"*. *Oxyloma* is known to occur in North America (north to Greenland), the British Isles, Europe (including Scandanavia), Asia (including the Soviet Union, Manchuria, Korea, Japan and India), and Africa (Egypt to South Africa).

Catinella

Species currently assigned to the genus *Catinella* occur in North America (into southern Canada), the British Isles, western Europe, ?Bonin Islands, Formosa and on various Polynesian Pacific islands where the greatest speciation has occurred. The Pacific species probably form a subgeneric group distinct from the Euro-American species. The shells of *Catinella* are often indistinguishable from *Succinea*, hence some *Catinella* species are surely still included in the genus *Succinea*. Further studies may broaden the known distributional limits of *Catinella*.

Quickia

Quickia, based on current data, is more limited in its distribution than *Succinea*, *Oxyloma* or *Catinella*. Six species of *Quickia* are known to occur in west-central coastal Africa and on its off-shore islands, on various island groups in the Indian Ocean, and in India where I recently studied 3 of the 6 known species. A species may also occur in the Andaman Islands, but its anatomy has not been studied. Odhner (1950) states in regard to the distribution of *Quickia:* "This peculiar distribution [excluding India] seems to indicate a splitting up of a once continuous circum-African range perhaps combined with the old Gondwana continent." If there is a correlation between the distribution of *Quickia* and the existence of Gondwanaland, then it is not surprising to find the genus distributed in India. Furthermore, areas of South America which, according to the theory of continen-

tal drift, were apposed to the present Liberian and Gulf coast of West Africa, and the western coast of Australia which was apposed to the eastern coast of India, need to be surveyed to determine if *Quickia* species occur on these continents as well.

Neosuccinea

prior to this study, only 1 species of *Neosuccinea* (from near Peking, China) was reported. An additional species, *N. kofui*, was recently discovered near Tokyo, Japan. Both species were originally thought to be *Succinea* until the reproductive anatomy was examined. Perhaps other Asian "*Succinea*" inhabiting the southern part of the continent will be found to belong to the genus *Neosuccinea*.

Indosuccinea

Indosuccinea is an arboreal species known to occur only in northern India from Bombay on the west to Manipur on the east and into Burma. Rao (1924) stated that "...there seem to be some closely allied forms, which probably extend the range of the genus into Indo-China and the Malay peninsula."

Camptonyx

Camptonyx is known to occur only in the Girnir Hills, Kathiawar, India.[6] Little is known about this highly endemic form.

Lithotis

Two species of *Litholis* are known, both from the western Ghats range south of Bombay, India. It appears that *Litholis* may be restricted to west-central India, but records are incomplete.[7]

Omalonyx

Omalonyx is a slug-like succineid inhabiting various islands in the West Indies, Central and South America. There are only a few recognized species and all are amphibious in habit, living near or on emergent vegetation of bodies of freshwater.

Hyalimax

Hyalimax is an arboreal succineid slug recorded from Zanzibar, Réunion Island, Burma and the Andaman and Nicobar islands. The shell of *Hyalimax* is entirely covered by the mantle, which separates it from *Succinea* s.s. on the basis of body form, even though their reproductive anatomy is similar. *Hyalimax* is here considered a subgenus of *Succinea*.

"Helisiga"

"Helisiga" is represented by 1 arboreal species actually belonging to *Succinea*. It is reported only from St. Helena Island in the South Atlantic Ocean.

---

[6] *Succinea bernardii* has been included in *Succinea, Omalonyx, Litholis* and *Camptonyx*. It's shell and ecological habitat resemble that of *L. rupicola*. Zilch (1959) lists Tahiti as a locality for *Camptonyx* s.s. (i.e., for *C.* (*C.*) *bernardii*). However, the anatomy of this Tahitian species shows that it is a *Succinea*.

[7] Zilch (1959) shows an illustration of *Erinna* (*Lanizia*) *carinata* from Reunion I. This supposedly lymnaeid species bears a resemblance to *Litholis* and may occupy a similar amphibious, high altitude habitat. It would be interesting to verify the placement of this species in the Lymnaeidae; it may instead belong to the Succineidae.

Succinoides

Succinoides stelliferus is the only known species for this genus. It is reported only from the Lenkoran lowland of Talysh, USSR.

Boninosuccinea

This genus is monotypic; the 1 species has a typically *Succinea*-shaped shell which is furnished with dense dotted spiral lines. The anatomy is unknown. It is from the Ogasawara (=Bonin) Islands.

Brachispira

According to Zilch (1959) this genus is widespread with numerous species. He illustrated a specimen from St. Vincent Island, Lesser, Antilles. The anatomy and valid distribution are unknown.

Papyrotheca

This is a fossil genus from southeast Europe.

Laxisuccinea

This genus is known only as fossils from Kauai Island, Hawaii.

In summary, the Succineidae is a land snail family of virtually worldwide distribution. The factors which promoted or led to such a distribution are unknown. Whether or not the current distribution of succineids has a relationship to continental drift is an interesting question which needs further study. The fact that the family is so widely distributed may be an indication of its great antiquity.

MORPHOLOGICAL AND ANATOMICAL FEATURES

The following is a discussion of the systematics and comparative morphology of the genera of Succineidae based on published works of other researchers and on the results of this study. Synonomies are not presented since they can be found in various other publications.

Succinea

The succineid species which are currently known anatomically mostly belong to the genus *Succinea*. The greatest number of species on which anatomical data are available are North American representatives studied by H. A. Pilsbry. The genus *Succinea* has been divided by various authors into several subgenera or sections. *S. putris* is the type species for the genus, which is the basis for the family Succineidae. Concerning morphological features of *Succinea*, Pilsbry (1948) summarized with the following statement: "Penis is without an appendix; it is provided with a sheath which may envelop the greater part of the penis, or all or part of the nearly straight, sinuous or looped epiphallus also. The vagina may be rather long or extremely short. The thin, ovate shell of about 2 1/2 to 3 whorls, though variable in degree of elongation, usually has shorter whorls than *Oxyloma*. The jaw has the usual median projection and sometimes some accessory ribs. The marginal teeth of the radula have low, wide basal plates." He further points out that in European and American *Succinea* the penial retractor muscle "...is attached at or near where the vas deferens passes into the epiphallus, with fibers running also to the distal extremity of the penial sheath... But while in those European species the epiphallus is merely a little sigmoid, in the Americans the epiphallus (sometimes with part of the penis also) is sufficiently redundant to form a loop between the two points of attachment of the retractor muscle...". He gave the American species the sectional name *Novisuccinea* to

separate them taxonomically from the European species. However, there is also a form in Japan (*?S. horticola*, see Habe, 1956) which on this basis corresponds to the *Novisuccinea* group, and *S. delalandei* from Africa also has an epiphallial loop. Thus, the occurrence of an epiphallial loop is not confined to only North American Succineidae. Pilsbry (1948) included the *S. ovalis* group in *Novisuccinea* s.s. and the *S. campestris* group in the section *Calcisuccinea*, a subdivision of *Novisuccinea*. Species he included in these respective groups do appear to form morphologically related assemblages. At this point it seems valid to speak of the *S. ovalis* and *S. campestris* groups, and perhaps even an *S. concordialis* group, but I would recommend discarding *Novisuccinea* and *Calcisuccinea* in order to avoid confusion with the subgeneric concept.

Webb (1954) designated the *Desmosuccinea* as a new section with *Succinea concordialis* (formerly placed in the *Calcisuccinea* by Pilsbry, 1948) as the genotype. He stated that *Desmosuccinea* differed from *Calcisuccinea* "...in having free-loop (epiphallus-homologue?) of penis degenerated into a vestigial conical caecum above the penis-vas deferens junction, and contained in the pore-less, enveloping sheath, and bearing the penis-retentor terminal...". However, topotype specimens from Lake Concordia definitely do not fit either Pilsbry's (1948) or Webb's (1954) anatomical description of *S. concordialis*. Nearly the entire epiphallus projects above the penis sheath and there are other differences as well. Other specimens collected at the Audubon Park in New Orleans, Louisiana and at Myakka State Park and near Tallahassee, Florida are similar in anatomy to the Lake Concordia specimens. None of these specimens fit existing species for which the reproductive anatomy has been described. It appears that the specimens dissected by Pilsbry (1948), Webb (1954) and Miles (1958) are not *S. concordialis*, and therefore the genotype of *Desmosuccinea* is a mis-identified species.

Webb (1953) named a new section, *Heysuccinea*, which was created to include *Succinea vaginacontorta*. He stated that this species differs from *Calcisuccinea* "...in having a prominent, dense, muscular basal twist of the vagina above the atrium, and with the vas-deferens free of the penis-vaginal crotch." Hubricht (1961) found *S. vaginacontorta* to be synonymous with *S. indiana* which was assigned by Pilsbry (1948) to the section *Novisuccinea*.

There are a great many succineid species in North American and especially in the southern United States. Most of these species have not been critically examined with regard to reproductive anatomy (especially the forms from the western United States), and until this is done it is premature to classify the North American *Succinea* species into various sections or subgenera.

Solem (1959) concluded that Indo-Pacific *Succinea* can be divided into 2 sections, *Papusuccinea* Iredale, 1941 and *Austrosuccinea* Iredale, 1939. Two characters were used to differentiate these groups in the following manner: *Papusuccinea* species have a smooth shell and supposedly the mesocone of the central tooth extends only slightly past the midpoint of the base, while *Austrosuccinea* species have microscopic criss-cross striations on the shell and a central tooth mesocone that ranges from 2/3 to as long as the base. However, it does not seem advisable to prematurely place the Indo-Pacific *Succinea* in sections or subgenera until more species have been critically studied with regard to internal reproductive anatomy. The reproductive anatomies of *Papusuccinea* and *Austrosuccinea* species have not yet been shown to differ significantly, radular characters are unreliable and at best, the shells present tenuous and superficial characters. Furthermore, the mesocone of the central tooth in *S. kuntziana* (placed in *Papusuccinea* by Solem, 1959) is not as described for the subgenus, but is 3/4 the length

of the base. Quick (1951) remarked that "It is generally agreed that the shells of *Succinea* of differing groups are often so much alike, and sometimes so variable in the same species, e.g., *pfeifferi*, that they do not form a reliable basis for classification. Iredale, 1937, agrees that dissection is necessary to determine the group to which a species belongs, so it is difficult to see why so many Australian succineids of which the anatomy is unknown are assigned to definite groups."

Zilch (1959) recognizes *Succinella* Mabille 1870 as a monotypic subgenus of *Succinea*, containing *S. oblonga*. However, Kiauta & Butot (1968) reviewed the anatomical studies of Quick (1933) on *S. oblonga* and they concluded that "We fully admit that the group of *Succinella* Mabille, 1870 needs comparison with groups of *Novosuccinea* Pilsbry, 1948; *Calcisuccinea* Pilsbry, 1948; *Desmousuccinea* Webb, 1954, and *Truella* Pease, 1871 which have been classified as subgenera of *Succinea* Draparnaud. Taking into account the above evidence, however, we feel justified to suggest that *Succinella* Mabille, 1870 should be raised to full generic rank in the Succineinae."[8] Admittedly, *S. oblonga* is a distinctive European species. If, however, one compares *S. oblonga* with other *Succinea* species, it is found that *S. oblonga* is not unique. For example, its jaw is not significantly different from various *Succinea* occuring in other geographical areas (e.g., *S. lauta* from Japan, *S. kuntziana* from the New Hebrides, most North American *Succinea*). *S. lauta* from Japan has a very long, convoluted and looped vas deferens, although this was not pointed out by Habe (1956). Crystalline bodies occur in *Oxyloma*, *Lithotis* and some *Succinea;* thus they cannot be used as a generic character. It appears then that the morphological characters which Kiauta & Butot (1967) use to support their move to raise *Succinella* to full generic rank are not sufficiently distinct from those occurring in other *Succinea*.

Another subgenus listed by Zilch (1959) is *Truella* Pease, 1871. Two species from Tahiti and 1 species from Kauai Island, Hawaii, are included in this subgenus. It is separated from other *Succinea* on the basis of the shell only. Thus, the validity of this subgenus is questionable until the various species can be studied anatomically.

Lesson (1831) named the genus *Helisiga* from St. Helena Island and considered it distinct from helicids, vitrinids and testacellids mainly on characters of the shell and external body appearance. Lesson apparently did not recognize the relationship of *H. sanctaehelenae* to succineids. It is an arboreal form which has a reddish-brown lustrous shell and reddish tinged body. I have examined the anatomy of *Helisiga* and can verify that *H. sanctaehelenae* should be placed in the genus *Succinea*. The terminal male genitalia is typically like that of *Succinea;* that is, there is an ample penial sheath surrounding the penis and epiphallus, the penial retractor muscle attaches on the sheath and at the junction between the epiphallus and vas deferens. Other reproductive characters, jaw and the shell are also like those of *Succinea*.

In summary, the genus *Succinea* is represented by a worldwide distribution of species possessing a broad spectrum of intergrading characters. Based on current morphological and anatomical information, the genus cannot be subdivided taxonomically with assurance except into *Succinea* s.s. and *Hyalimax*. This should not imply that other valid subgenera do not exist, only that they

[8] *Novosuccinea* should read *Novisuccinea* and *Desmousuccinea* should read *Desmosuccinea* in the correct form.

cannot be clearly and unquestionably recognized on the basis of characters examined in those species studied to date.

The morphology and reproductive anatomy of *Succinea putris* and *S. kuntziana* were presented in this report. *S. putris*, although the type species for the genus, is rather unique with regard to the many folds or sinuosities present on the anterior margin of the cutting piece of the jaw. *S. kuntziana* is quite typically *Succinea*-like in its reproductive anatomy, but it is the only species reported to possess a variability with regard to the epiphallus being completely contained within the penial sheath in some individuals while in others it protrudes in a loop from the posterior end of the penial sheath. Several tropical species of *Succinea* have a reddish tinge of color in the head-foot region. *S. kuntziana* is 1 of these species and according to Lesson, *S. sanctaehelenae* from St. Helena also has a reddish appearance. Other species from Hawaii and Tahiti are also colored slightly red. This reddish coloration is not restricted to the genus *Succinea*. *Quickia* sp. from Aldabra Atoll and some populations of *Catinella rotundata* from Hawaii also exhibit some reddish body coloration. Among *Succinea*, and other genera as well, there is a great amount of variability in the extent of mantle and head-foot pigmentation, which ranges from forms almost devoid of any pigment to those nearly completely covered with pigment, which is usually black melanin. Likewise, a similar variability occurs in regard to pigmentation on internal organs. Concerning reproductive organs, variability is readily apparent in the terminal reproductive tracts of *Succinea*, especially with regard to thickness and structure of the penial sheath, shape and structure of the penis and epiphallus, attachment of the penial retractor muscle, structure and length of the vas deferens, length of the anterior common reproductive channel, length and shape of the vagina and length of the spermathecal duct to name a few. Shell shape and variability in sculptural features among *Succinea* species is almost infinite.

Hyalimax

The named genus *Hyalimax* H. & A. Adams (1855) includes succineid representatives which have a slug body form. The genus is currently divided into 2 subgenera, *Hyalimax* s.s., which includes the African species, and *Jarava* Godwin-Austen (1882), which includes species from India and the Andaman Islands. Some radular and jaw features vary to some extent from *Succinea* species examined morphologically, but the reproductive anatomy of *Hyalimax* is of the *Succinea* type (e.g., with the presence of a penial sheath and absence of a penial appendix). Thus, it is recommended that the succineid slug genus *Hyalimax* more correctly be considered a subgenus of *Succinea*. Whether the Indian and African forms are truly distinct still needs to be verified.

Quick (1939) gave a thorough account of morphological and anatomical features of *Hyalimax mauritianus*. The specimens were slightly smaller than those of *H. maillardi* I studied, but their shells were of approximately the same size. The shell of *H. mauritianus* is very close morphologically to *H. maillardi's* shell. The jaw of the 2 species is also similar. Their radulae are similar, except that the anterior projections in the basal plate are longer in *H. mauritianus* and the base also appears to be broader. The structure of the reproductive tract of *H. maillardi* differs from that of *H. mauritianus* in the following features: (1) A large portion of the penis and the epiphallus are not contained within the penial sheath, whereas in *H. mauritianus* the penis and epiphallus are entirely enclosed by the penial sheath, and (2) the ovotestis duct and receptacula seminis are pigmented with black in *H. mauritianus*, but are without pigment in *H. maillardi*. The 2 species are similar with regard to other reproductive anatomical features.

However, the differences thus cited substantiate the fact that the 2 species are clearly distinct.

Oxyloma

Oxyloma is a succineid genus of relatively wide distribution and it is characterized by having a thin attenuate shell in which the whorls are somewhat flattened above the periphery and the spire is short. It is anatomically distinguished by the presence of a penial sheath which surrounds a penis that bears an appendix at its posterior end and a convoluted epiphallus. Other anatomical features are similar to *Succinea* species.

Zilch (1959) lists 3 subgenera of *Oxyloma* Westerlund (1885), *Oxyloma* s.s (type *Succinea dunkeri*), *Neoxyloma* Pilsbry (1948) (type *Succinea effusa*) and *Hydrotropa* Lindholm (1927) (type *Succinea pfeifferi*). Of these subgenera, *Hydrotropa* was considered by Quick (1933, 1936) to belong to *Oxyloma* on jaw characters which are highly variable and the anatomy of *O. pfeifferi* is not significantly different from that of other European and African forms, I concur with Quick's opinion that *Hydrotropa* should be dropped.

Pilsbry (1948) found that *Oxyloma* species in North America could be divided into 2 groups in which "(1) The penis is straight posteriorly, terminating in an appendix and a closely coiled, convoluted epiphallus of small diameter. Section *Oxyloma* s.s.; (2) The penis is bent at its summit, or coiled in a half turn, more or less, before giving off an appendix and a straight or moderately sinuous epiphallus. Section *Neoxyloma*, new section." He related that although *Neoxyloma* "...is rather weakly differentiated from typical *Oxyloma*, the difference seems worth notice in view of the geographic segregation." *O. groenlandica*, which is found in Greenland and Iceland, is the only North American species which corresponds to the European species contained in *Oxyloma* s.s. Based on our knowledge of the relatively few species described anatomically, it would seem that the separation of the North American *Oxyloma* into the subgenera *Neoxyloma* and *Oxyloma* s.s. is valid.

Species of *Oxyloma* from Africa (including *O. cleopatrae*) and from India belong anatomically to *Oxyloma* s.s. According to the anatomical illustrations and descriptions in Habe's (1956) paper, the Japanese and Manchurian species are also contained in *Oxyloma* s.s. *O. lejavai* from the Soviet Union, studied by Hudec (1966) is also an *Oxyloma* s.s. species. Available anatomical information indicates that only the North American species form a distinct group and that there is an extreme conservatism with regard to anatomical change within both subgenera. There is some variation in the size and shape of the penis and penial appendix, the length and degree of coiling of the epiphallus, the amount of mantle and body pigmentation, and shell size, shape and coloration. In most cases, the shell of *Oxyloma* is readily distinguishable from that belonging to other genera. However, I found a Mexican species, presumed to belong to *Oxyloma* on shell characters, was anatomically a *Succinea* species. Thus, the *Oxyloma* shell is not necessarily distinctive.

The morphological and anatomical features of *Oxyloma cleopatrae* were presented in this study. When compared to other anatomically known African *Oxyloma* species (*O. connollyi*, *O. patentissima*, *O. pseudomalonyx*) as well as other *Oxyloma* s.s. species, *O. cleopatrae* is distinct in having a reduced penial appendix. Such a reduction is not confined to this species, since a similar reduction is seen in *O.* (*Neoxyloma*) *retusa* from North America. In other anatomical and morphological features (including the jaw), *O. cleopatrae* is similar to other *Oxyloma* s.s. members. The number of lateral teeth (8) and marginal teeth (31) is fewer

than reported in the other African *Oxyloma* and more characteristic of the condition in the European species. However, variability in radulae is so prevalent among succineids that one cannot discern valid relationships based on number of teeth present. From Rao's (1924) anatomical description of *Succinea indica*, the species can be included in *Oxyloma* and it appears that *O. indica* is related to the African and European forms. Rao stated, based on shell characters, that an *Oxyloma* form recorded from Alexandria by Jickeli is "...at best a form of *S. indica*." However, the penial appendix is longer and "finger-shaped" (Rao, 1924) in *O. indica*, which is a condition unlike the reduced appendix of the specimens of *O. cleopatrae* from Alexandria which I studied. The genus *Oxyloma* has not been previously included in the taxonomic ranks of the Indian succineid genera.

Omalonyx

A detailed account of the morphological features and reproductive anatomy of a representative of the genus *Omalonyx* has been presented for only 1 species, *O. felina*. A brief description of some anatomical features of *O. patera* was given by Parodiz (1963). However, it is impossible to interpret his anatomical illustrations, so that nothing can be concluded concerning specific differences between *O. felina* and *O. patera* based on reproductive anatomy.

The genus *Omalonyx* is currently divided into 2 subgenera, *Omalonyx* s.s. and *Neohyalimax*. Simroth (1896) presented a rather thorough account of the body, jaw and shell morphology and also reproductive anatomy of *O.* (*N.*) *brasiliensis* which he then considered a subgenus of *Hyalimax* but recognized its possible relationship to *Omalonyx*. There appears to be a close similarity between *O.* (*N.*) *brasiliensis* and *O.* (*O.*) *felina* in the length of the vagina, interior penial papillae and short anterior common reproductive channel. He did not discern an epiphallus, apparently the penis was relatively shorter than in *O. felina* and he recorded only 1 receptaculum seminis whereas 2 are present in *O. felina*. The body form of *O.* (*N.*) *brasiliensis* is slug-like, as is that of *O. felina*, but the shell of *O.* (*N.*) *brasiliensis* is completely covered by the mantle (the shell is exposed in *O. felina*). The shell is also completely covered in *Hyalimax* with which *Neohyalimax* was originally placed. The flat, oval shell of *Neohyalimax* differs from the slightly arched shell of *Hyalimax* and the whorled shell of *Omalonyx*. The body pigmentation of *O.* (*N.*) *brasiliensis* is similar to that of *O.* (*O.*) *felina*. *Hyalimax* possesses a *Succinea* type of reproductive anatomy. Thus, *O.* (*N.*) *brasiliensis* with an *Omalonyx* type of reproductive anatomy cannot be considered a subgenus of *Hyalimax*, but is more properly placed in the genus *Omalonyx*. Simroth (1896) recorded the presence of only 1 pair of tentacles in *O.* (*N.*) *brasiliensis*, whereas representatives belonging to *Omalonyx* s.s. have 2 pairs. The loss of the ventral tentacle pair has also occurred in *Lithotis* and in some other stylommatophoran groups as well. It does seem justifible to consider *Neohyalimax* as a valid subgenus of *Omalonyx* based on their respective morphology and anatomical features.

Neosuccinea

The generic distinctness of *Neosuccinea* was first recognized by Matekin (1953). He dissected 1 specimen of *"Succinea" chinensis* Pfeiffer which was collected near Peking, China. Matekin provided outline illustrations of the shell, jaw and radula, but he did not give a description of either the jaw or radula. The shells of *Neosuccinea kofui* from Japan which were used in this study vary somewhat from Matekin's drawing, but they do resemble more closely the photograph of *N. chinensis* in Zilch (1959). The radula of *Neosuccinea kofui* is distinctly dif-

ferent from that shown for *N. chinensis* (Matekin, 1953, fig. 3) in the following morphological features: (1) The anterior margin of the cutting piece is much less convex; (2) the extremities of the arms of the cutting piece are more rounded and (3) the basal accessory plate is much wider. Matekin did not give the radular formula for *N. chinensis*, but said only that "The jaw and the radula of *S. chinensis* do not have specific peculiarities." Such a comment would also pertain to *Neosuccinea kofui* from Japan. There are, however, some noticeable differences in the reproductive anatomy of the Chinese and Japanese forms. Matekin described the albumen gland of *N. chinensis* as small and spoon-like, and the prostate gland as small and round. The albumen gland of the Japanese form is moderately large and the prostate is not round but rather oblong in shape. The intense black pigmentation of the ovotestis duct, receptacula seminis and fecundation pouch was not recorded for *N. chinensis*. Matekin reported the absence of a penial sheath and epiphallus in *N. chinensis*. The Japanese form clearly has a thin penial sheath and an epiphallus which, although scarcely discernible externally, is clearly demarcated internally from the penis. The broad dilation of the vas deferens as it leaves the junction with the prostate gland (which is characteristic of the Japanese *Neosuccinea*) was not described for the Chinese specimen. The shape of the vaginal appendix was also somewhat different in the 2 forms. Matekin described the lower 1/3 of the uterus (=oviduct) to have characteristically very wrinkled walls in the inside. Although he considered this feature generically important, I cannot discern any featuers particularly unique about the oviduct of the Japanese species. Internal folds are present along the oviduct of virtually all succineids, although they may vary in size and regularity. In comparison to *N. chinensis*, differences in some of the antomical features of the Japanese *Neosuccinea* form delineate it as a distinct species.

Neosuccinea appears to be most closely related to *Succinea* in anatomical morphological features.

Succinoides

The type species, *Succinoides stelliferus*, is the only member of this genus. Morphological features of its shell, jaw, radula and internal structure are basically like those of *Succinea*. It is distinguished from *Succinea* by the presence of a sucker on the penis near the opening of the vas deferens (Schileyko, 1967). There is no epiphallus.

Indosuccinea

Only 2 species of *Indosuccinea* have been studied anatomically, *I. semiserica* Rao and *I. khandalla* (Rao). Members of this genus were included in the subfamily Catinellinae (which lacks a penial sheath) by Odhner (1950). However, specimens of *I. khandalla* do possess a distinct penial sheath and hence the genus cannot be placed with the sheathless forms in Catinellinae, but must be placed with the sheath bearing forms in the Succineinae.

Indosuccinea semiserica from Manipur, Bengal (and presumably also from Burma)and *I. s. sthulasiras* from Calcutta have a short bulbous penis and the ducts of the vagina, penis and spermatheca have separate external openings into the genital aperture according to Rao (1924). This means, in effect, that a vagina does not exist in these forms. Thus, it is my opinion that the following distinct features of *I. s. khandalla* Rao, in comparison to other *Indosuccinea* populations, support its elevation to full specific rank: (1) The presence of a longer penis which possesses a well developed penial sheath and (2) the joining of the spermathecal duct and oviduct to form a vagina nearly equal in length to the penis.

Rao (1924) in naming *Indosuccinea* as a new genus, gave the following diagnosis for the genus: "Thus the very fragile nature of the shell, its characteristic shape, the highly vascular lung, the strongly chitinized jaw with beak-like extremities to the arms, the large number of marginals in the radula, and in the genitalia the spiral torsion of the prostate, the very short vas deferens with a small bulbous penis devoid of a retractor muscle, the spermathecal duct having a separate external opening instead of being connected with the vagina, and above all the terrestrial habit are the distinctive characters proposed of the new genus." It might be recalled that although the shell of *Indosuccinea* is fragile, it is not unique in this regard, because species belonging to other genera such as *Catinella* and *Omalonyx* also have fragile shells. The highly vascular lung is reminescent of the lung condition in *Omalonyx* and perhaps other slug-like forms. *I. khandalla* does not have beak-like extremities on the arms of the jaw. Above all, a terrestrial habit is not unique to *Indosuccinea*, but is also the habit of many *Succinea* and *Catinella* species. Thus, the diagnosis of the genus *Indosuccinea* needs to be changed to take into account some of these points as well as the anatomical features of *I. khandalla*. *Indosuccinea* is a succineid genus of arboreal habit having the following combination of characters: A thin, fragile shell of 1 1/2 whorls and having fine growth striae; a highly vascular lung; the right tentacle assembly passing on the inside of the terminal genitalia; the penis is sheathed, bulbous or of moderate length but without a penial retractor muscle; vagina present or absent and a spiral torsion of the prostate gland is evident. If more species of *Indosuccinea* are discovered and their anatomy should differ, the diagnosis of the genus will then have to be revised accordingly.

Lithotis

This little known genus contains only 2 named species, *Lithotis rupicola* (the type) and *L. tumida*. The reproductive anatomy of *L. rupicola* is now quite thoroughly described, but *L. tumida* is unknown in this regard. The shell form of the latter is more elevated and consists of 2 1/2 to 3 whorls, but it still possesses an internal furrow like *L. rupicola*. The jaw and radula of the 2 forms are different (Rao, 1924). It would be of great interest to ascertain if *L. tumida* has only 1 receptaculum seminis and a penial structure similar to that of *L. rupicola*. Indeed, *L. rupicola* exhibits some of the most unique reproductive anatomical features of the family Succineidae. The relationship of *Lithotis* to other succineid genera, especially *Camptonyx* (unknown anatomically), *Indosuccinea*, *Succinea* and *Quickia* is an imposing question.

Catinella

The genus *Catinella* Pease (1871) comprises 2 groups of species. *Catinella* s.s. are mostly arboreal and inhabit various Pacific islands. They have depressed shells with very reduced spires consisting of only 1-2 whorls and a large oval aperture. *Quickella* Boettger (1939) is found in terrestrial amphibious habitats and is common in North America, but rare in Europe (including Britain). They have shells with elevated spires of 2-3 whorls and relatively smaller apertures. The North American species were formerly placed in a separate subgenus, *Mediappendix* Pilsbry (1948).

Catinella is distinguished from other succineid genera by the following combination of characters: (1) The penis is without a sheath, and (2) the right tentacle assembly passes on the outside of the penis between the latter and the terminal female reproductive tract. The North American and European species possess a penial appendix. The Pacific *Catinella* s.s. are said to lack a penial appendix

(Odhner, 1950). Odhner did not consider the Pacific forms subgenerically distinct from the North American and European ones but concluded that "...the sections *Mediappendix* and *Quickella* may be retained." *C.* (*Q.*) *arenaria* is the only European species belonging to *Quickella* and is characterized by having a rudimentary penial appendix. In the North American forms studied, the penial appendix is a well developed appendage. Otherwise, the North American and European species are anatomically indistinguishable. Furthermore, according to Odhner (1950) the shape of the penis of *C. rubida* from Hawaii is essentially like that of *C. arenaria* and has a slightly protruding fundus along 1 side. Odhner does not show such a fundus in *C. rotundata*. However, in specimens of *C. rotundata* I examined (identified by Dr. Yoshio Kondo, B.P. Bishop Museum, Honolulu) there is a well developed protrusion on the inner side of the apical portion of the penis which resembles the rudimentary penial appendix of *C. arenaria* (see Quick, 1933). Thus, it appears that the presence of a penial appendix (although perhaps rudimentary) cannot be ruled out as an anatomical feature of *Catinella* s.s. species. Although *Catinella* s.s. species have not been reported to have an epiphallus, the specimens of *C. rotundata* and *C. putamen* both appear to possess a structure which corresponds to the epiphallus of some *Succinea*. In *C. rotundata*, the penis narrows abruptly posteriorly and an epiphallus emerges from 1 side of the apical portion of the penis. The epiphallus is about 1/2 the length and 1/4 the diameter of the penis, thickwalled and furnished with internal folds. The penial retractor muscle attaches at the junction of the epiphallus and vas deferens. The epiphallus of *C. putamen* and that of *C. vermeta* have been previously described in this report. Furthermore, Quick (1933, pl. 24, fig. Q) shows a structure on *C. arenaria* which appears to be similar to the epiphallus of other *Catinella*, especially *C. vermeta* and *C. rotundata*.

Based on information available for the few species studied, it seems worthwhile nevertheless to recognize 2 *Catinella* groups, (1) the arboreal Pacific species belonging to the subgenus *Catinella* s.s. and (2) the amphibious Euro-American species complex which is assigned to the subgenus *Quickella*. The haploid chromosome number of 2 *Catinella* s.s. species is n=5; the Euro-American *Quickella* species have 6 pairs of chromosomes.

Morphological and anatomical features of 2 species of *Catinella* (*C. putamen* from Samoa and *C. vermeta* from the U.S.A.) were described in this report. *C. putamen* is anatomically similar to most other Pacific *Catinella* except in 2 features: (1) There is an epiphallus which emerges from the side of the penis and (2) the spermathecal duct is extremely short and stout in *C. putamen*. Additionally, a vagina hardly exists in *C. rubida* and *C. rotundata* and is extremely short in *C. baldwini* and is absent in *C. putamen*. The radula of *C. putamen* has fewer marginal teeth than in the other Polynesian species. Odhner (1950) characterized *Catinella* s.s. as having a radula "...with marginals 3-4 times the laterals in number...". Such is not the case in *C. putamen*. The shell is larger and heavier in *C. putamen* than in the other Polynesian species, but it resembles the shell form of *C. rotundata* and *C. rubida* in having few whorls and a large, oval aperture.

The North American *Catinella vermeta* is similar in most respects to the other described species of *Catinella* from the U.S.A. The reproductive systems of *C. vermeta*, *C. texana*, *C. aprica*, *C. wandae* and *C. oklahomarum* appear to be very similar except for the size and shape of the penis and its appendix and the position of the appendix. Webb (1953) stated that *C. wandae* had a larger prostate gland than *C. vagans* (=*C. vermeta*). A thorough comparative anatomical study is needed among the named species of *Catinella* and those yet undiscovered from North America to determine the limits of variability in reproductive structures

and assess their use in the designation of species. Certainly all the forms examined to date are closely related and belong to the same species group. It appears that the European species (*C. arenaria*) is hardly distinct from the North American species.

Quickia

The succineid genus *Quickia* was named by Odhner (1950) in honor of H. E. Quick, who was the first to describe the unique anatomical features of *Q. concisa*. *Quickia* is characterized by an ovate-conical shell which is regularly and finely striate in the line of growth, has 3 whorls, an ovate aperture and a columellar plait which may possess a fold. The right tentacle retractor muscle and the tentacular and optic nerves are placed to the inside of the terminal reproductive apparatus. The penis possesses a penial retractor muscle, but it is without a penial sheath. The penis may possess a penial apron; the vagina is long or short and the prostate gland is flattened. Prior to this study only the type species, *Q. concisa* (Morelet) was assigned to the genus. There are now 2 subgenera, *Quickia* s.s. and *Burchella*. The former includes 3 named species, *Q.* (*Q.*) *concisa*, *Q.* (*Q.*) *spurca* (Gould) and *Q.* (*Q.*) *bensoni* (Pfeiffer), while *Burchella*, to date, includes only *Q.* (*B.*) *calcultensis* Patterson. Species belonging to *Quickia* s.s. lack a penial apron which is present in *Burchella*.

Pilsbry (1919) in reference to *"S." concisa* stated: "This species is probably, as Ancey [1888] has stated, identical with *S. spurca* Gould, described from Liberia. The anatomy of the reproductive system of *Quickia concisa* was described by Quick (1936). Anatomically, *Q. spurca* from Liberia is certainly closely related to *Q. concisa*. Like *Q. concisa*, the shell of *Q. spurca* possesses a sculpture of fine growth striae and granulaform inclusions. When the periostracum is removed, the shell has a silvery-white appearance. Quick (1936) described the presence of 3 spiral mud ridges deposited on the shell as "...very characteristic" for *Q. concisa*. Such mud ridges or ribs are not typically present on shells of all adult *Q. spurca*.

The jaw of *Q. spurca* is only slightly different than that of *Q. concisa*. The median prominence of *Q. spurca* is small, but it is somewhat more developed in *Q. concisa* (c.f., Quick, 1936, fig. 19). Quick reported a radular formula of 11:10:1:10:11 in *Q. concisa*, whereas I found that *Q. spurca* specimens usually had 12 to 14 marginal teeth. However, the form of the various radular teeth was the same in the 2 species.

Greater differences between *Q. concisa* and *Q. spurca* were evident in several features of the reproductive tracts. The prostate gland of *Q. spurca* (and also a form from Aldabra) appears as a rather loose collection of 5 to 7 bunches of branching tubules which give the appearance in situ (end view) of oblong-spheroid shaped bodies which are opaque white in color. Quick (1936) described the prostate of *Q. concisa* as yellow and very small, but he made no mention of the *Q. spurca* sort of prostate gland, even though such a condition differs considerably from the prostate gland appearance in other succineid genera. Quick (1936) described the penial retractor muscle in *Q. concisa* as "...short and slender...arises much more anteriorly from the body-wall on the right side of the neck, near the front end of the diaphragm." This condition has never been observed in *Q. spurca*. A fecundation pouch is present in *Q. spurca*, but such a structure was not described by Quick for *Q. concisa*, although undoubtedly it was present. Due to differences in the description of the reproductive anatomy of *Q. concisa* and the comparative observations on *Q. spurca*, especially the insertion of the penial retractor muscle, I conclude that the 2 species are distinct and should not be considered synonymous as Pilsbry (1919) recommended.

Prior to this study, *Quickia* (*Q. concisa*) was reported only from several West African Gulf countries and some off-shore islands, and from various islands in the Indian Ocean. Several species are now known to exist in India. (*Q. bensoni*, *Q. calcuttensis*, *Q. gravelyi*, *Q.* sp. from Cortallam Falls). I was interested in comparing the morphological and anatomical features of the 2 Indian forms studied with conditions described for *Q. spurca* from Liberia. Because *Q. bensoni* belongs to the subgenus *Quickia* s.s., it will first be compared (below) to *Q. spurca* (also belonging to *Quickia* s.s.) and then *Q.* (*Burchella*) *calcuttensis* will be compared to *Q. bensoni*.

The shells of *Quickia bensoni* from India and *Q. spurca* from Liberia are not significantly different, and in fact there are several striking similarities between the 2 forms: (1) They are similar in shape, (2) spiral mud ribs are deposited on the shells of some specimens of both species and mud is commonly found on all specimens, (3) the growth striae are similar in fineness and regularity, (4) both are translucent white after removal of the periostracum, and (5) both have finely punctate shells, and (6) both species show a considerable amount of variation in shell shape. The habitats of the 2 species are apparently quite similar.

The jaw of *Quickia bensoni* is somewhat different from that of *Q. spurca* in that in the latter species the anterior margin is very depressed and has a median prominence which is lacking in *Q. bensoni*.

There is a rather gradual transition from lateral to marginal teeth in *Quickia bensoni*, whereas in *Q. spurca* the first marginal is clearly distinct from the last lateral. In other aspects, the radulae of the 2 forms do not differ.

In comparison to the African *Quickia spurca*, *Q. bensoni* shows several prominent differences in reproductive anatomy, such as (1) a larger ovotestis having many more acini, (2) a convoluted, pigmented ovotestis duct, (3) a prostate gland with many more smaller tubules which are more compactly organized, (4) a much shorter vagina, (5) the attachment of the penial retractor muscle below the tip of the penis (it attaches at the tip in *Q. spurca*), and (6) the penis and vagina are of nearly equal length (the penis is only about 1/6 the length of the vagina in *Q. spurca*).

In comparing *Quickia calcuttensis* to *Q. bensoni* one finds that the shell is different in (1) color, (2) lack of appreciable variation in shape among individuals of the populations, (3) lack of mud deposition, (4) lack of punctae and (5) presence of a noticeable columellar fold. However, the shell of *Q. calcuttensis* is similar in shape and growth striae to the more ovate forms of *Q. bensoni*. The habitats of the 2 species differ greatly.

The jaw of *Quickia calcuttensis* has a somewhat different shape from that of *Q. bensoni*, but their radulae are similar except for the presence of more teeth per row in *Q. calcuttensis*.

With regard to reproductive anatomy, *Quickia calcuttensis* differs from *Q. bensoni* not only in the possession of a penial apron, but in the following other features: (1) Some internal organs are slightly colored by a dull orange or light orange-yellow pigment; (2) the ovotestis follicles are fewer and larger; (3) the vas deferens is relatively longer; and (4) the penial retractor muscle attaches on the vas deferens. A striking and perhaps important similarity is the same short vaginal length and also similar prostate gland morphology in both Indian species. *Q. calcuttensis* is clearly more closely related to *Q. bensoni* than to *Q. spurca*.

Currently, species of *Quickia* are known from Calcutta in the northeast to Cortallam Falls near the southern tip of peninsular India. More extensive collections will undoubtedly broaden the distribution of *Quickia* in that country. Also, several Indian species now placed in *Succinea* will probably be found to belong to

Quickia. Two subgenera of Indian *Quickia* are recognized. It is recalled that *Q. concisa* and the Liberian *Q. spurca* have a long vagina whereas both of the Indian forms studied have a short vagina and radular features somewhat different from *Q. spurca*. The African *Quickia* may possibly form a subgeneric group distinct from the Indian forms.[9] However, until more African and Indian species of *Quickia* are examined anatomically, the limits of and variation in the systematic importance of the vaginal length cannot be determined. In any case, the African and Indian species of *Quickia* seem to have experienced a considerable amount of evolutionary divergence.

The Succineidae were divided into 2 subfamilies by Odhner (1950), the Succineinae and the Catinellinae, on the basis of the presence of a penial sheath in representatives belonging to the former and the absence of a penial sheath in the latter. The penial apron has not been recorded to exist in any succineid prior to this study. Its function is unknown, but it is innervated by the penial nerve, as is the penial sheath of the species placed in the subfamily Succineinae. The question arises as to whether or not the penial apron represents a transitional form between the sheathless and sheathed penes found in Succineidae. If it is truly an intermediate form, then the validity of the 2 subfamilies, Catinellinae and Succineinae, is questionable.

KEY TO THE VALID GENERA AND SUBGENERA OF SUCCINEIDAE

1a Penis with a penial sheath . . . . . Subfamily SUCCINEINAE . . 2
1b Penis without a penial sheath . . . . . Subfamily CATINELLINAE . 7
2a Penis exceptionally long . . . . . Genus *Omalonyx* 8
2b Penis short or of moderate length 3
3a Penis short and without a penial retractor muscle, right tentacle assembly passes between penis and terminal female genitalia 4
3b Penis of moderate length and without a retractor muscle, right tentacle assembly passes between penis and terminal female genital tract, vagina with or without an appendix 5
4a Penis short and stout, two receptacula seminis present . . Genus *Indosuccinea*
4b Penis short, saccular and not stout, one receptaculum seminis present . . . . . Genus *Lithotis*
5a Penis of moderate length, vaginal appendix present . . . . Genus *Neosuccinea*
5b Penis of moderate length and with or without an appendix, with or without a sucker, vaginal appendix absent 6
6a Penis with a sucker and without an appendix . . . . . Genus *Succinoides*
6b Penis without a sucker and without an appendix . . . . . Genus *Succinea*[10] 9
6c Penis without a sucker and with an appendix . . . . . Genus *Oxyloma* 10
7a Right tentacle assembly passes between penis and terminal female genital tract . . . . . Genus *Quickia* 11
7b Right tentacle assembly passes between penis and terminal female genital tract . . . . . Genus *Calinella* 12

[9] Should this be the case then *Quickia* s.s. would include *Q. concisa* and *Q. spurca* only. A new subgenus would have to be named to include *Q. bensoni* which is currently placed in *Quickia* s.s. solely on the absence of a penial apron.

[10] Includes the genera "*Hyalimax*" and "*Helisiga*."

8a	Shell exposed	Subgenus *Omalonyx* s.s.
8b	Shell covered entirely by the mantle	Subgenus *Neohyalimax*
9a	Shell exposed	Subgenus *Succinea* s.s.
9b	Shell covered entirely by the mantle	Subgenus *Hyalimax*
10a	Posterior end of penis straight or nearly so, with appendix arising from the penial tip	Subgenus *Oxyloma* s.s.
10b	Posterior end of penis bent over before giving off an appendix	Subgenus *Neoxyloma*
11a	Penis without a penial apron	Subgenus *Quickia* s.s.
11b	Penis with a penial apron	Subgenus *Burchella*
12a	Arboreal species	Subgenus *Catinella* s.s.[11]
12b	Amphibious species	Subgenus *Quickella*

MAJOR ANATOMICAL CHARACTERS OF SUBFAMILIES AND GENERA STUDIED

Character	Taxon
Penial sheath absent	Subfamily CATINELLINAE
Right tentacle assembly passes on the outside of the terminal genitalia	Genus *Catinella*
Right tentacle assembly passes on the inside of the terminal genitalia	Genus *Quickia*
Penial sheath present	Subfamily SUCCINEINAE
Penis exceptionally long	Genus *Omalonyx*
Penis of moderate length and penial appendix present	Genus *Neosuccinea*
Penis of moderate length and penial appendix present	Genus *Oxyloma*
Penis of moderate length and wihtout an appendix	Genus *Succinea*
Penis of moderate length and penial sucker present	Genus *Succinoides*
Penis exceptionally short; two receptacula seminis present	Genus *Indosuccinea*
Penis exceptionally short; one receptaculum seminis present	Genus *Lithotis*

[11] The separation of *Catinella* into subgenera may be open to question. However, ecologically and cytologically there exist 2 species groups.

CLASSIFICATION OF RECENT SUCCINEIDAE

Phylum Mollusca
Glass Gastropoda
Subclass Euthyneura
Order Stylommatophora
Suborder Heterurethra
Family Succineidae

Current	Revised
Subfamily Catinellinae	Subfamily Catinellinae
Genus *Catinella*	Genus *Catinella*
Subgenus *Catinella* s.s.	Subgenus *Catinella* s.s.
Subgenus *Quickella*	Subgenus *Quickella*
Subgenus *Mediappendix*	
Genus *Quickia*	Genus *Quickia*
	Subgenus *Quickia* s.s.
Genus *Indosuccinea*	Subgenus *Burchella*
Subfamily Succineinae	Subfamily Succineinae
Genus *Succinea*	Genus *Succinea*
Subgenus *Succinea* s.s.	Subgenus *Succinea* s.s.
Subgenus *Succinella*	Subgenus *Hyalimax*
Subgenus *Novisuccinea*	
Subgenus *Calcisuccinea*	
Subgenus *Desmosuccinea*	
Subgenus *Heysuccinea*	
Subgenus *Papusuccinea*	
Subgenus *Austrosuccinea*	
Subgenus *Truella*	
Genus *Oxyloma*	Genus *Oxyloma*
Subgenus *Oxyloma* s.s.	Subgenus *Oxyloma* s.s.
Subgenus *Neoxyloma*	Subgenus *Neoxyloma*
Subgenus *Hydrotropa*	
Genus *Boninosuccinea*	Genus *Boninosuccinea*+
Genus *Neosuccinea*	Genus *Neosuccinea*
Genus *Camptonyx*	Genus *Camptonyx*+
Gekns *Lithotis*	Genus *Lithotis*
Genus *Indosuccinea*	Genus *Indosuccinea*
Genus *Omalonyx*	Genus *Omalonyx*
Subgenus *Omalonyx* s.s.	Subgenus *Omalonyx* s.s.
Subgenus *Neohyalimax*	Subgenus *Neohyalimax*
Genus *Hyalimax*	
Subgenus *Hyalimax* s.s.	
Subgenus *Jarava*	
Genus *Brachyspira*	Genus *Brachyspira*+
Genus *Helisiga*	Genus *Succinoides*

+indicates there is no anatomical data to support the classification

CYTOTAXONOMY

Changes in chromosome numbers in animals may occur by (1) chromosomal fusion; (2) fragmentation; (3) mitotic or meiotic non-disjunction; (4) translocation involving a supernumerary fragment serving as a donor of a centromere and 2 telomeres and (5) duplication of entire chromosomal complements through polyploidy. Chromosomal fusion produces a decrease in chromosome number while the other conditions result in an increase in chromosome number. Changes in the chromosomal complement that involve the loss or gain of incomplete chromosomal sets occur by aneuploidy in contrast to polyploidy, the duplication of entire chromosome sets. Because most variation in molluscan chromosome numbers within a taxon is seldom greater than ±1 or 2 bivalents, mechanisms for addition or deletion of chromosomes must operate at a low or inefficient level. Nevertheless, nearly all changes in chromosome numbers that did occur and are now evident undoubtedly represent aneuploid conditions which stabilized. Furthermore, basic diploid species can tolerate duplications or additions of chromosomes more easily than loss of chromosomes (see Husted & Burch, 1946), and therefore, variation in chromosome number within a taxon probably more usually reflects addition of rather than loss of chromosomes. When the variation in chromosome number between lower taxonomic categories exceeds 1 or 2 bivalents, i.e., 3 or 4 or more (but less than an additional complement of chromosomes), this most likely represents successive aneuploid conditions, each change followed by a period of stability in the new chromosome number. Accordingly, one may expect to find more primitive mollusks to have lower chromosome numbers and species derived from them to often have a greater number of chromosomes. When an unexpectedly low chromosome number is found in an advanced group, this number either represents an unchanged ancestral condition or it has resulted from successive reductions in the chromosome number. Subsequent chromosome number increases may be expected in either case, which would be primary increases in the former case and secondary increases in the latter. However, in referring to chromsome number change as an increase or decrease, care must be taken in assessing which groups are morhpologically primitive or advanced. It often appears that the determination of whether or not a taxon is "primitive" or "specialized" ("advanced") is quite subjective and is not determined by careful analysis of many detailed characters. The lack of sufficiently critical morphological studies and careful analyses relating to phylogeny pose serious questions for the molluscan cytotaxonomist.

The Stylommatophora has been divided into 4 suborders: (1) The Orthurethra which is considered by Pilsbry (1900) to be the most primitive suborder; (2) the Heterurethra which is somewhat more advanced; (3) the Mesurethra which is considered by Baker (1961) and Pilsbry (1946) to be close to the Orthurethra and (4) the Sigmurethra which is the most advanced group. Currently, the athoracophorid slugs are included with the Succineidae and Aillyidae in the Heterurethra. Haploid chromosome numbers of stylommatophoran snails are summarized in Table 2.

It has already been suggested by several molluscan systematists that the Succineidae (suborder Heterurethra) represents the most primitive land snail group. Various morphological features possessed by succineids make them an ideal ancestral stylommatophoran. If the suggestion (Burch, 1965) that higher chromosome numbers correlate with phylogenetically more advanced or morphologically specialized euthyneuran snail groups while lower chromosome numbers are generally found in more "primitive" groups is true, then cytotaxonomic in-

TABLE 2. Haploid chromosome numbers of the Stylommatophora.

Group	Mean	Mode	No. families	No. species
HETERURETHRA	17.1	18	2	45
MESURETHRA	25.7	24	2	24
ORTHURETHRA	26.2	29	7	24
SIGMURETHRA	28.6	29	21	145

formation seems to support the view that the Succineidae is the most primitive land snail group. The mean number of chromosomes in the Heterurethra (which includes n=44 for *Aneitea* sp., an athoracophorid slug (Patterson, unpublished)) is the lowest among all land snail groups (see Table 2). The suborder Sigmurethra, considered the most advanced stylommatophoran group, has the highest mean number of chromosomes (28.6).

Although as a family, the Succineidae does not exhibit the conservativeness with regard to chromosomal number change which is evident in most other molluscan families, there appears to be some evidence of conservativeness at the generic or subgeneric taxonomic levels. Chromosome numbers are known for only relatively few succineids, but based on the information available, there is an indication that cytotaxonomic data is of potential value in assessing the systematic affinities of species in question.

Members currently assigned to the subfamily Catinellinae (*Catinella* and *Quickia*) appear to be cytologically conservative at the generic level in *Quickia* and at the subgeneric level in *Catinella*. For example, all 5 *Quickia* species from Africa and India have 25 pairs of chromosomes. This is the only succineid genus known to have this haploid chromosome number. It will be interesting to determine the chromosome numbers of other *Quickia* species to ascertain if the haploid number 25 is indeed a generic characteristic.

The division of the genus *Catinella* into the subgenera *Catinella* s.s. and *Quickella* rests mostly on their geographical separation and different ecological habitats. Two arboreal Pacific species assigned to *Catinella* s.s. have 5 pairs of chromosomes, while 7 Euro-American amphibious species have the chromosome number n=6. Thus, based on information now available, the division of *Catinella* into 2 subgenera seems to gain support from their diversity in chromosome numbers. The chromosome number of more *Catinella* species, especially from the Pacific area, needs to be determined for verification of this cytotaxonomic distinction at the subgeneric level.

There is more variability in chromosome numbers among genera assigned to the subfamily Succineinae. Species belonging to the genus *Succinea* have haploid chromosome numbers that range from n=11 to n=22. All species studied cytologically belong to the subgenus *Succinea* s.s.; the chromosomes of *Hyalimax*, the other subgenus, have never been studied. The greatest number of *Succinea* studied are from the southern United States and all have 18 pairs of chromosomes, except *S. grosvenori* which has n=19. *S. ovalis*, from the mid-West, north-eastern United States and south-eastern Canada, has 21 pairs of chromosomes. This species is morhpologically and ecologically quite distinct from the other North American *Succinea*. Whether this higher chromosome number (n=21) corresponds with an increased morphological and ecological specialization of *S. ovalis* when compared to other North American forms is an intriguing question. *S. ovalis* is

more distantly related to the European *S. putris* than to its North American *Succinea* neighbors. *S. putris* from France and *S. lauta* from Japan are very similar morphologically and both have 22 pairs of chromosomes.

Chromosome numbers are available for both subgenera of *Oxyloma*. Species belonging to *Oxyloma* s.s. have haploid chromosome numbers of n=15, n=17 and n=18. Since only 5 species from widely separated geographical areas have been examined cytologically, little can be said about cytotaxonomic relationships in *Oxyloma* s.s. All 3 North American *Neoxyloma* species studied cytologically have 19 pairs of chromosomes. Although the separation of these 2 subgenera is rather tenuous on morphological grounds, the chromosome number (n=19) of *Neoxyloma* species seems to add support to its distinct subgeneric rank. However, more species need to be studied cytologically.

Only 1 species has been studied cytologically in the genera *Indosuccinea*, *Lithotis*, *Neosuccinea* and *Omalonyx*. Until more cytological information is gained for these groups, suggestions of their relationships to other Succineinae cannot be made on cytotaxonomic considerations.

When considering the family Succineidae, the genus *Catinella* "...is regarded as more primitive than the other genera, in which the penis is provided with a sheath..." (Pilsbry, 1948). Certainly the low chromosome numbers (n=5, n=6) of *Catinella* species tends to support such a contention based on current suggestions of cytotaxonomy of mollusks. Odhner (1950) felt that *Quickia* is more primitive than *Catinella* based on the terminal male reproductive tract anatomy. The haploid chromosome number of *Quickia* (n=25) species makes one reconsider the phylogenetic position of *Quickia* within the Succineidae and especially within the Catinellinae. Earlier (p 193) a question was raised, based on considerations of reproductive anatomy, whether *Quickia* is rightfully included in the Catinellinae or whether there exist 2 valid subfamilies in the Succineidae based on characters currently studied with regard to systematic relationships within the groups. The same question can be raised based on cytological information. Certainly the haploid chromsome number of *Quickia* (n=25) is widely separated from n=5 or 6 for *Catinella*. Also, the 2 genera are quite different morphologically. The alternatives are then (1) to have no subfamilies or (2) to have 3 subfamilies with the addition of Quickinae. Information is not sufficient at present to make any such changes in the current taxonomic scheme. However, the question should be kept in mind.

With the determination of more succineid species' chromosome numbers, it is hoped that cytotaxonomic information will further aid in the ability to arrive at a concrete understanding of systematics in the Succineidae.

SUMMARY AND CONCLUSIONS

Morphology of the shell, jaw and radula, reproductive anatomy and cytotaxonomy of 8 of the 12 recent genera of Succineidae were considered. Anatomical features of the reproductive system are most important for characterizing the genera while morphology of the shell, jaw and radula may, in some cases, be useful for delineating species.

The division of the Succineidae into 2 subfamilies by Odhner (1950), Catinellinae (species lacking a penial sheath) and Succineinae (species with a penial sheath) is provisionally maintained.

As a result of this study, *Indosuccinea*, formerly placed in Catinellinae by Odhner (1950), is now understood to be included in the Succineinae because it possesses a penial sheath. *"Helisiga" sanctaehelenae* has no morphological

features which separate it from *Succinea* and, in fact, their reproductive anatomy is similar. Because *"Hyalimax" maillardi* has a slug-like body form, without an external shell, it can be considered a distinct subgenus of *Succinea*, but not a separate genus because of its *Succinea*-like reproductive anatomy. *Succinea* was formerly divided into 9 subgenera, but morphological evidence support a valid division into only 2 subgenera, *Succinea* s.s. and *Hyalimax*.

The division of *Oxyloma* into *Oxyloma* s.s. and *Neoxyloma* by Pilsbry (1948) appears to be valid based on morphological characters. Also, only the North American *Oxyloma* (*Neoxyloma*) have the chromosome number n=19. Other *Oxyloma* have 15 to 18 pairs of chromosomes.

Catinella has been understood to contain 3 subgenera, *Catinella* s.s., *Mediappendix* Pilsbry (1948) and *Quickella* Boettger (1939). However, there is no evidence to separate the North American *Catinella* (*Mediappendix*) from the European *Quickella;* thus, it is recommended to consider the Pacific *Catinella* s.s. and Euro-American *Quickella* as the only subgenera of *Catinella*.

Quickia, which contained only 1 species prior to this investigation, now includes at least 6 species and 2 subgenera (*Quickia* s.s. and *Burchella*). The subgenus *Burchella* is characterized by having a penial apron, a structure found for the first time among succineids.

Succineids should be considered members of the order Stylommatophora. However, they do share some morphological characteristics in common with some members of the more primitive gastropod groups such as the Basommatophora, Soleolifera and Opisthobranchia. Such morphological evidence appears to support the contention that the Succineidae are the most primitive land snail group from which the other Stylommatophora have evolved.

Zoogeographical data shows that members of the Succineidae are worldwide in distribution. *Succinea* is the most widely distributed genus and found on every major continent. *Oxyloma* is found in the Americas, Europe, Africa and some Pacific areas. *Omalonyx* inhabits Central and South America and their off-shore islands. *Catinella* occurs on various Pacific Islands, in North America and Europe. *Quickia* is an Afro-Indian genus, while *Lithotis* and *Camptonyx* are restricted to India. *Indosuccinea* occurs mainly in India and Burma. Information is sparse concerning the distribution of the other recent genera since so few species have been discovered.

Haploid chromosome numbers range from n=5 to 25 among the 44 species studied. The family Succineidae is the major group belonging to the stylommatophoran suborder Heterurethra. The mean haploid chromosome number for the Heterurethra is 17.1 which is more than 8 bivalents lower than the mean for any of the other 3 suborders (see Table 2). If the suggestion (Burch, 1965) that lower chromosome numbers are generally found in more "primitive" groups is true, then cytotaxonomic data seems to support the view, based on morphology, that the Succineidae is the most primitive land snail group.

Although there is a wide range of haploid chromosome numbers within the Succineidae, there is some evidence for conservatism with regard to chromosome number change at the generic or subgeneric taxonomic levels. For example, all *Quickia* have 25 pairs of chromosomes, both *Catinella* s.s. have 5 pairs while *Quickella* is characterized by n=6 and all *Neoxyloma* have 19 bivalents. Thus, there is an indication that cytotaxonomic information may be an aid in assessing systematic affinities of various succineids.

ACKNOWLEDGEMENTS

This study was made possible through the generosity, interest and encouragement of many people. Dr. J. B. Burch gave me guidance in selecting the problem, and his knowledge of the Stylommatophora, his patient understanding and encouragement are deeply appreciated. I would also like to thank the other members of my doctoral committee, Drs. Henry van der Schalie, Helen Gay and Robert J. Lowry for reading and improving the manuscript and for their interest in the study.

I would like to thank the following people for supplying specimens discussed in this study: Dr. J. B. Burch, Mr. Leslie Hubricht, Dr. Yoshio Kondo, Dr. Henry van der Schalie, Mr. Richard Russell, Mrs. Sharon McDonald, Dr. Joyce Rigby, Mr. John Peake, Dr. J. Gaillard, Dr. Dee S. Dundee, Dr. Wm. Sodeman, Dr. C. A. Wright, Dr. R. Natarajan, Dr. Artie Metcalf and Dr. Fred G. Thompson.

Gratitude is expressed to Dr. J. B. Burch and Dr. R. Natarajan for the opportunity to collect Indian succineids through participation in their "Chromosomes of Indian Mollusks" program supported by grant SFC-7427 from the Smithsonian Institution, Washington, D.C.

Mr. John Tottenham and Mrs. Martha Lackey (Museum Staff Artist) are thanked for preparing the shell illustrations.

LITERATURE CITED

ADAMS, H. & A. 1855. *The genera of recent Mollusca; arranged according to their organization.* 2: 93-284. London, 1855.

AMIN-UD-DIN. 1921 The amphibious Pulmonata (Succineidae). *In:* ANNANDALE, N., PRASHAD, B. & AMIN-UD-DIN, 1921. The aquatic and amphibious Mollusca of Manipur. *Rec. Indian Mus.*, 22(4): 529-631, pls. 4-8.

ANCEY, M. C. V. 1888. Catalogue des mollesques terrestres et fluviatiles recoltes sur la cote occidentale d'Afrique by M. le cap Vignon. *Bull. Soc. malacol. Fr.*, 5: 65-76.

BAKER, H. B. 1925. The Mollusca collected by the University of Michigan-Williamson expedition in Venezuela, III. *Occ. Paps. Mus Zool., Univ. Mich.*, (156): 1-44, pls. 1-11.

BAKER, H. B. 1926. The Mollusca collected by the University of Michigan-Williamson expedition in Venezuela, IV. *Occ. Paps. Mus. Zool., Univ. Mich.*, (167): 1-49, pls. 12-19.

BAKER, H. B. 1955. Heterurethrous and aulacopod. *Nautilus*, 68(4): 109-112.

BAKER, H. B. 1961. Puerto Rican pupillids and clausilioids. *Nautilus*, 75(1): 33-36.

BOETTGER, C. R. 1939. Bemerkungen über die in Deutschland vorkommenden Bernsteinschnecken (Fam. Succineidae). *Zool. Anz.*, 127(3/4): 49-64.

BLANFORD, W. T. 1863. Description of *Cremnobates syhadrensis* and *Lithotis rupicola*, two new generic forms of mollusca inhabiting cliffs in the Western Ghats of India. *Ann. Mag. natur. Hist.*, (3) 12: 184-187, pl. 4.

BURCH, J. B. 1964a. Chromosomes of the succineid snail *Catinella rotundata*. *Occ. Paps. Mus. Zool., Univ. Mich.*, (638): 1-8.

BURCH, J. B. 1964b. The chromosomes of *Catinella vermeta* (Mollusca, Euthyneura, Succineidae). *Acta biol. Acad. Sci. hung.*, 15(1): 87-94.

BURCH, J. B. 1965. Chromosome numbers and systematics in euthyneuran snails. *Proc. first Europ. malacol. Congr.*, 1962, p 215-241.

BURCH, J. B. 1969. Cytological studies of Pacific land snails. *Proc. Symp. Moll. II, Mar. biol. Assoc. India*, 1969: 616-625.

BURCH, J. B. & PATTERSON, C. M. 1969. The systematic position of the Athoracophoridae. *Malacologia*, 9(1): 259-260.

BURCH, J. B., PATTERSON, C. M. & NATARAJAN, R. 1966. Chromosomes of four species of North American Succineidae. *Venus*, 24(4): 342-353.

BUTOT, L. J. M. & KIAUTA, B. 1964. Voorlopig rapport over der de chromosomen van vier Nederlandse succineiden. *Corresp. Ned. malacol. Ver.*, 111: 1163-1164.

BUTOT, L. J. M. & KIAUTA, B. 1967. The chromosomes of *Catinella arenaria* (Bouchard-Chantereaux, 1837) with a review of the cytological conditions within the genus *Catinella* and considerations of the phylogenetic position of the Succineoidea ord. nov. (Gastropoda: Euthyneura). *Beaufortia*, 14(174): 157-164.

COOK, H. 1966. Morphology and histology of the central nervous system of *Succinea putris* (L.). *Arch. néerl. Zool.*, 17(1): 1-72.

COOKE, C. M. Jr. 1921. Notes on Hawaiian Zonitidae and Succineidae. *Occ. Paps. Bernice P. Bishop Mus.*, 7(12): 263-277, pls. 24-25.

COOKE, C. M. Jr. & CLENCH, W. J. 1945. New species of *Succinea* from Tahiti, with remarks on other Polynesian species. *Occ. Paps. Bernice P. Bishop Mus.*, 18(8): 133-138.

DRAPARNAUD, J. P. R. 1801. *Tableau des mollusques terrestres et fluviatiles de la France.* p 1-116, pls. 1-13. Paris, 1801.

FISCHER, P. 1867. Anatomie de deux mollusques pulmones terrestres appartenant aux genres *Xanthonyx* et *Hyalimax*. *J. Conchyliol.*, 15(3): 213-221, pl. 10.
FRANZEN, D. S. 1959. Anatomy of *Succinea ovalis* Say. *Proc. malacol. Soc. London*, 33(5): 193-199.
FRANZEN, D. S. 1963. Variations in the anatomy of the succineid gastropod *Oxyloma retusa*. *Nautilus*, 76(3): 82-95.
FRANZEN, D. S. 1964. Anatomy of the succineid gastropod *Oxyloma haydeni*. *Nautilus*, 77(3): 74-81.
FRANZEN, D. S. 1966. Anatomy of the succineid gastropod *Oxyloma salleana* (Pfeiffer). *Nautilus*, 79(3): 82-95.
GODWIN-AUSTEN, H. H. 1882. *Land and freshwater Mollusca of India*, Part I., 226 p, London, 1882.
GOULD, A. A. 1846. (Descriptions of shells). *Proc. Boston Soc. natur. Hist.*, 2: 182-185.
GOULD, A. A. 1850. (Descriptions of new species). *Proc. Boston Soc. natur. Hist.*, 3: 193.
GUPPY, R. J. L. 1872. Third series of additions to the catalogue of the land and freshwater Mollusca of Trinidad, with a revised list of all species. *Proc. Scient. Assoc. Trinidad*, 2: 17-25.
HABE, T. 1956. Anatomical studies on the Japanese land snails (4) genera of the family Succineidae. *Venus*, 19(2): 100-108.
HANLEY, S. & THEOBALD, W. 1876. *Conchologia Indica*: Illustrations of the land and freshwater shells of British India. L. Reeve & Co., London., p 1-65, pls. 1-160.
HUBRICHT, L. 1961. Eight new species of land snails from the southern United States. *Nautilus*, 75(1): 26-32.
HUDEC, V. 1966. *Succinea* (*Oxyloma*) *lejavai* n.sp. aus der Grusinischen SSR. *Arch. Molluskenk.*, 95 (3/4): 143-149.
HUSTED, L. & BURCH, P. R. 1946. The chromosomes of polygyrid snails. *Amer. Natur.*, 80: 410-429.
IREDALE, T. 1937. A basic list of the land Mollusca of Australia. *Austr. Zool.*, 8(4): 287-333.
IREDALE, T. 1941. A basic list of the land Mollusca of Papua. *Austr. Zool.*, 10(1): 51-94, pls. 3-4.
KIAUTA, B. & BUTOT, L. J. M. 1968. The chromosomes of *Succinea* (*Succinella*) *oblonga* Draparnaud, 1801, with considerations on the status of the subgenus *Succinella* Mabille, 1870 (Gastropoda, Euthyneura: Succineoidea). *Beaufortia*, 16(210): 1-11.
KOYAMA, T. 1955. Studies on the chromosome numbers of two species of *Succinea* in Japan. *Venus*, 18: 259-265.
LA COUR, L. 1941. Acetic-orcein: A new stain-fixative for chromosomes. *Stain Techn.*, 16: 169-174.
LEE, C. B. 1951. *Succinea vaginaconlorta* (section *Calcisuccinea*), a new amber snail from Kansas. *Occ. Paps. Mus. Zool., Univ. Mich.*, (533): 1-7, pls. 1-2.
LESSON, R. P. 1831. Histoire naturelle des Zoophytes recueillies dans le voyage de la corvette La Coquille. *Voy. "Coquille", Zool.*, 2(1): 58-471.
LINDHOLM, W. A. 1927. Zur Nomenklatur einiger paläerktischer Landschnecken-Gattungen. *Arch. Molluskenk.*, 59(6): 321-331.
LINNAEUS, C. 1758. Systema naturae, ed. 10 reformata 1. *Holmiae* 1758.
MATEKIN, P. V. 1956. Systematic position of *Succinea chinensis* Pf. 1877 (Gastropoda, Pulmonata, Stylommatophora). *Reps. Acad. Sci. USSR*, 111(4): 901-902.
MILES, C. D. 1958. The family Succineidae (Gastropoda: Pulmonata) in Kansas. *Univ. Kansas Sci. Bull.*, 38 Part II, (24): 1499-1543.
MORELET, A. A. 1848. Testacea quaedam Africae occidentalis terrestria et fluviatilia. *Rev. Zool.*, 11: 251-355.
NATARAJAN, R., HUBRICHT, L. & BURCH, J. B. 1966. Chromosomes of eight species of Succineidae (Gastropoda: Stylommatophora) from the southern United States. *Acta biol. Acad. Sci. hung.*, 17(1): 105-120.
NEWCOMER, E. H. 1953. A new cytological and histological fixing fluid. *Science*, 118(3058): 161.
ODHNER, N. H. 1950. Succineid studies: Genera and species of the subfamily Catinellinae. *Proc. malacol. Soc. London*, 28(5): 200-210.
ORBIGNY, A. d'. 1841. Mollusques. *In:* R. De La SAGRA, *Histoire physique, et naturelle de l'Ile de Cuba*. Paris, 1839-42.
PALLARY, M. P. 1909. Cataloque de la faune malacologique d'Egypte. *Mem. Inst. Egypt*, 6(1): 1-89, pls. 1-5.
PARODIZ, J. J. 1963. Observaciones anatomicas sobre *Omalonyx patera* Doer., con una nota biografica acerca de Adolfo Doering (1848-1926). *Sterkiana*, 12: 1-7.
PATTERSON, C. M. 1968. The reproductive anatomy and chromosome number of *Quickia sparca* (Gould) (Stylommatophora: Heterurethra: Succineidae). *Malacol. Rev.*, 1: 1-13.
PATTERSON, C. M. 1969. Chromosomes of molluscs. *Proc. Symp. Moll.*, II, *Mar. biol. Assoc. India*, 1969: 635-686.
PATTERSON, C. M. 1970. Morphological and cytological studies of the succineid genus *Quickia* from India. *Malacol. Rev.*, 3(1): 25-36.
PATTERSON, C. M. & BURCH, J. B. 1966. The chromosome cycle in the land snail *Catinella vermeta* (Stylommatophora: Succineidae). *Malacologia*, 3(3): 309-325.

PEASE, W. H. 1871. Catalogue of the land-shells inhabiting Polynesia, with remarks on their synonymy, distribution, and variation, and descriptions of new genera and species. *Proc. zool. Soc.*, 1871: 449-477.
PERROT, M. 1938. Etude de cytologie comparée chez les gastéropodes pulmonées. *Rev. suisse Zool.*, 45(20): 487-566.
PFEIFFER, L. 1849. Descriptions of twelve new species of *Vitrina* and *Succinea*, from the collection of H. Cuming, Esq. *Proc. zool. Soc. London*, 1849: 133.
PILSBRY, H. A. 1900. On the zoological position of *Partula* and *Achatinella*. *Proc. Acad. natur. Sci. Philad.*, 1900(3): 561-567.
PILSBRY, H. A. 1919. A review of the land mollusks of the Belgium Congo chiefly based on the collections of the American Museum Congo Expedition, 1909-1915. *Bull. Amer. Mus. natur. Hist.*, 15: 1-pls. 1-23.
PILSBRY, H. A. 1946. *Land Mollusca of North America (north of Mexico)*. Acad. natur. Sci. Philad., Monogr. No. 3, 2(1): 1-520.
PILSBRY, H. A. 1948. *Land Mollusca of North America (north of Mexico)*. Acad. natur. Sci. Philad., Monogr. No. 32(2): 521-1113.
QUICK, H. E. 1933. The anatomy of British Succineae. *Proc. malacol. Soc. London*, 20(6): 295-318, pls. 1-2.
QUICK, H. E. 1934. The development of the radula and jaw and of the specific differences in young *Succinea pfeifferi* Rossm. and *Succinea putris* (L.). *Proc. malacol. Soc. London*, 21(2): 96-103.
QUICK, H. E. 1939a. Some particulars of four Indo-Pacific *Succinea*. *Proc. malacol. Soc. London*, 23(5): 298-302.
QUICK, H. E. 1939b. On *Succinea andecola*. *Proc. malacol. Soc. London*, 23: 333-335.
QUICK, H. E. 1939c. *Hyalimax mauritianus* Fischer, a succineid slug from Mauritius. *Mauritius Inst. Bull.*, 1(5): 57-61, pl. 3.
QUICK, H. E. 1951. *Succinea archeyi* Powell. *Rec. Auck. Inst. Mus.*, 4(2): 123-126.
RAINER, M. 1967. Chromosomenuntersuchungen an Gastropoden (Stylommatophora). *Malacologia*, 5(3): 341-373.
RAO, H. S. 1924. Asiatic Succineidae in the Indian Museum. *Rec. Indian Mus.*, 26: 367-408, pl. 28.
RAO, H. S. 1925. On certain succineid molluscs from the Western Ghats, Bombay Presidency. *Rec. Indian Mus.*, 27(5): 385-400.
RIGBY, J. E. 1965. *Succinea putris:* A terrestrial opisthobranch mollusc. *Proc. zool. Soc. London*, 144(4): 445-486.
SAY, T. 1824. Descriptions of some new terrestrial and fluviatile shells of North America. *N. Harmony Dissem. useful Knowl.*, 2: 213-220.
SCHILEYKO, A. A., 1967. Some new and little known mollusks of Talysh. *Biol. Sci.*, 4: 24-31.
SIMROTH, H. 1896. On *Neohyalimax brasiliensis*, n.gen., n.sp. (Allied to *Hyalimax*), from Brasil. *Proc. malacol. Soc. London*, 2: 39-45, pl. 5.
SOLEM, A. 1959. Systematics and zoogeography of the land and freshwater Mollusca of the New Hebrides. *Fieldiana*, 43: 1-359.
SOLEM, A. 1969. Phylogenetic position of the Succineidae. *Malacologia*, 9(1): 289.
VAN MOL, J.-J. 1967. Etude morphologie et phylogénétique de ganglion cerebroide des gastéropodes pulmonés (Mollusques). *Mem. Acad. roy. Belg.*, 37(5): 1-168, pls. 1-3.
WEBB, G. R. 1953. Anatomical studies on some midwestern Succineidae and two new species. *J. Tenn. Acad. Sci.*, 28(3): 213-220.
WEBB, G. R. 1954. Pulmonata, Succineidae: *Succinea (Desmosuccinea) pseudavara*, new section and species. *Gastropodia*, 1(2): 10, 18-19.
WESTERLUND, C. A. 1855. Fauna der in der Palläarctischen Region. *Binnenconch.*, 5: 1-135.
ZILCH, A. 1959. Gastropoda. 2. Euthynerua. *In:* SCHINDEWOLF, *Handbuch der Paläozoologie*. Bronntraeger, Berlin, 6(2): 1-400.

C. M. PATTERSON

Museum and Department of Zoology
The University of Michigan
Ann Arbor, Michigan 48104

BRIEF COMMUNICATIONS

* * * * * * *

A BIOLOGIST'S LOOK AT THE HISTORY OF MUSCLE SHOALS (MUSSEL SHOALS). — Dexter (1961) in his account of "Mussel Shoals vs. Muscle Shoals," Alabama, has stated the concern of biologists (malacologists) about the name Muscle Shoals (Mussel Shoals). Dexter noted that malacologists are seldom concerned with etymology of place-names but are concerned with "Mussel Shoals vs. Muscle Shoals."

During my recent residence in the Muscle Shoals area the question of the origin of the name Muscle (Mussel) Shoals has arisen on numerous occasions by local residents and others. Reading extensively from the history of the region has been inadequate for resolving this toponymical problem. With the exception of Davidson (1946) and Anonymous (1941), historians have treated this problem very casually.

Leftwich (1935) in her book *Two Hundred Years at Muscle Shoals* accepted the popular account that the name Muscle Shoals was based on a "popular story that the Indians named the rapids 'Muscle Shoals' because it required 'heap big muscle' to get their canoes around the place." Anonymous (1941) states, "About 1779 the first white rivermen paddled into the region and established a trading post there. They named the rapids Muscle or Mussel Shoals, suggested either by the abundant shellfish or the strong arm muscles required to paddle a boat through the rapids."

Davidson (1946) in his history of the Tennessee River noted that the name Muscle Shoals may have an antiquity greater than has previously been accredited. Davidson, expounding in the mode of an ecologist, noted the great shoals with its numerous rocks, rivlets, and continuous "...currents must have been especially agreeable to mussels." Davidson stated that no matter how or when the name arose, "Muscle Shoals was always, surely first of all the place of mussels"(Fig. 1).

A map by Imlay (1795) showed the "mussel shoals" while other material of that period referred to "Muscle Shoals." Dexter (1961) noted that there was evident uncertainty from the very beginning about the origin and spelling of the name. Dexter noted that U.S. Board on Geographic Names rendered a decision in favor of the use of "Muscle Shoals" on April 5, 1892, ". . . in view of past usage."

Dexter (1961, 1967) noted that the spelling of "muscle" in reference to bivalve mollusks was common in the Alabama-Tennessee region in earlier times, and throughout there has been confusion world-wide about the name used in reference to freshwater bivalve mollusks. Dexter stated, "In general, use of the spelling 'muscle' is an old and obsolete form whereas 'mussel' is more recent and preferred."

Eminent malacologists, including Conrad (1834), Ortmann (1924), and Van der Schalie (1939), have noted the important contribution of the Muscle (Mussel) Shoals to the North American molluscan fauna. The following is quoted from Conrad in the interest of those laymen who do not have access to such historical material. "The bivalves are . . . peculiarly abundant in those rivers of north Alabama and Tennessee, which have cut their channels in the carboniferous limestone, and where generally a long grass affords them a secure hold against the rapid current of these mountain streams. The expansion of the Tennessee River, known by the name of Muscle Shoals, is of the character I have described; it is shallow, ornamented with a number of small islands, and its bed is full of the long grass which abounds in various species of naiades." "Bivalves" and "Naiades" as used here by Conrad refer to mussels.

It may be of interest to some that the muscle shoals are the result of minor swells in the St. Louis limestone which lift the ". . . Fort Payne chert above the bed of the river for 35 miles above Florence, Alabama . . ." creating a total fall of 140 feet (Fenneman, 1938). The shoals actually extend 53 miles (Tennessee River Mile 234.6-287.7). This reach contained 4 principal shoals: moving upstream, Colbert Shoals at mile mile 234.6, Little Muscle Shoals, Big Muscle Shoals, and Elk River Shoals terminating at mi. 287.7(Droze,1965).

Ortmann (1924) stated unequivocally that the "mussel shoals" received their names from the immense number of freshwater mussel species found there and that the ". . . now official spelling should be discarded for the more correct one 'mussel shoals.' "

Van der Schalie (1939) noted that presence of the mussel shoals afforded a special ecological condition requisite for the large number of mussel species reported from the Tennessee River in that area.

Archaeological reports of Webb & De Jarnette (1942, 1948) attested to the importance of mussels to pre-Columbian Americans in the area. Stansbery (1964) and Isom (1969) gave additional information on the present mussel fauna of the muscle shoals. They reported the loss of a significant number of native mussel species on the muscle shoals following impoundment of the river in the Muscle Shoals area (Figure 2).

As Dexter noted, there is no overwhelming historical evidence for changing the name of Muscle Shoals to Mussel Shoals.

FIG. 1. Site of Wilson Dam on the Muscle Shoals.

FIG. 2. Wilson Dam on the Muscle Shoals.

LITERATURE CITED. — ANONYMOUS. 1941. *Alabama. A guide to the deep south.* Hastings House, New York, 442 p. — CONRAD, T. A. 1834. *New freshwater shells of the United States.* Philadelphia, p 12-13 (from Ortmann, 1924). — DAVIDSON, D. 1946. *The Tennessee*, Vol. 1: *The old river frontier to secession.* Rinehart & Co., Inc., New York, 342 p. — DEXTER, R.W. 1961. Mussel Shoals vs. Muscle Shoals. *Sterkiana* 4: 29-31. — DEXTER, R. W. 1967. Addenda on mussel vs. muscle. *Sterkiana* 27: 1-2. — DROZE, W. H. 1965. *High dams and slack waters.* Louisiana State Univ. Press, Baton Rouge. 174 p. — FENNEMAN, N. M. 1938. *Physiography of Eastern United States.* McGraw-Hill Book Co., New York, p 423-424. — IMLAY'S American Topography. 1795. *A map of the Tennassee Government formerly part of North Carolina.* J. Debrett, London. — ISOM, B. G. 1969. The mussel resource of the Tennessee River. *Malacologia*, 7(2-3): 397-425. — LEFTWICH, N. 1935. *Two hundred years at Muscle Shoals.* Multigraphic Advertising Co., Birmingham, Alabama, 280 p. — ORTMANN, A. E. 1924. Mussel Shoals. *Science*, 60(1564): 565-566. — STANSBERY, D. H. 1964. The Mussel (Muscle) Shoals of the Tennessee River revisited. *Amer. malacol. Union ann. Reps.*, 1964, 31: 25-28. — VAN DER SCHALIE, H. 1939. Additional notes on the naiades (freshwater mussels) of the Lower Tennessee River. *Amer. midl. Natur.* 22(2): 452-457. — WEBB, W. S. & DE JARNETTE, D. L. 1942. An archaeological survey of Pickwick Basin in the adjacent portions of Alabama, Mississippi and Tennessee on the Tennessee River. *Bull. Bur. Amer. Ethnol.*, No. 129, Wash., 536 p. — WEBB, W. S. & DE JARNETTE, D. L. 1948. Little Bear Creek Site CT°8. *Ala. Mus. Nat. Hist., Museum paper* 26, Univ. Ala., 64 p.

REFERENCES FOR ADDITIONAL READING. — CAMPBELL, T. J. 1932. *The Upper Tennessee.* Campbell Chattanooga, Tenn., 145 p. — DAVIDSON, D. 1948. *The Tennessee*, Vol. 2: *The New River Civil War to TVA.* Rinehart & Co., Inc., New York, 377 p. — GARRET, J. K. 1964. *A History of Lauderdale County, Alabama.* (Pub. privately), 264 p. — GARRETT, J. K. 1968. *A History of Florence, Alabama.* (Pub. privately), 288 p. — GOODRAM, J. C., et al. 1968. *Rivers of Alabama.* Strode Pub., Huntsville, Ala., 211 p. — MORRISON, J. P. E. 1942. Preliminary report on mollusks found in the shell mounds of the Pickwick Landing Basin in the Tennessee River Valley. *Bull. Bur. Amer. Ethnol.*, 129: 339-392. — SKINNER, C. L. 1919. *Pioneers of the old Southwest.* Yale Univ. Press, 304 p.

* * * * * * *

BILLY G. ISOM, *Environmental Biology Branch, Division of Environmental Research and Development, Tennessee Valley Authority, Muscle Shoals, Alabama* 35660, *U.S.A.*

* * * * * * *

* * * * * * *

A NOTE ON *MARTESIA STRIATA* (PHOLADIDAE) TUNNELLING INTO PLASTIC PIPING IN HONG KONG. — *Martesia striata* Linnaeus is one of the most destructive members of the Pholadidae. The species is particularly prevalent in the tropics (though often met with in European waters) where it may be found tunnelling into wood and soft stone. Annandale (1924) and McGlashan (1924) record it as occurring in brickwork, and Muraoka (1968) has stated that the same animal has been known to penetrate into the solid lead sheathings of submarine power cables. Balasubramanyan (1965) reported a species of *Martesia* attacking plastic sheeting in the port of Cochin. Unidentified pholads extensively attacked polymeric materials and cables left in the deep sea for 15 years (Connolly *et al.*, 1970). The related *Xylophaga washingtona* bores into a variety of plastics although apparently not into others (Muraoka, 1968, 1969).

Most instances of pholads boring into plastic originate in the benthos. *Martesia striata*, on the other hand, is an inhabitant of the surface waters and therefore potentially more detrimental to materials in the sea.

In Hong Kong waters *Martesia striata* has been found to be capable of tunnelling into the polyvinyl chloride inlet sea-water pipes of the cholorination pumps of the Hong Kong Electric Company in such numbers as to necessitate their removal and replacement due to leakage. This discovery raises a number of points that are relevant to opinions concerning the problems associated with tunnelling by marine borers.

1. It has been shown by Evans (1968) that members of the Pholadidae do not encroach into their neighbours tunnel or re-emerge from the wood or rock. This has been explained by Board (1970) for *Teredo* as an avoiding reaction to a gradient of decreasing hardness in which they find less support when flexing for further tunnelling. The same principles probably hold true for *Martesia* when tunnelling in naturally occurring substances. When tunnelling into polyvinyl chloride (Fig. 1), however, there is no gradient of decreasing hardness since this substance does not soften even when submerged for a number of years (Muraoka, 1969). Consequently the animals still find support even when they encroach into each others tunnel (Fig. 1 A, B) and when they bore straight through the piping (C), to emerge at the opposite surface.

2. Polyvinyl chloride is not attacked by weak acids or alkalis. The occurrence of *Martesia* in this substance therefore confirms that boring in this species is purely mechanical.

3. It has been suggested by Board (1970) that *Teredo* forces water into the heading of its tunnel to soften the wood and thereby aid tunnelling. This action may also be possible by pholads tunnelling into wood and

FIG. 1. Section through a piece of polyvinyl chloride piping, showing the burrows of 5 specimens of *Martesia striata* L. (See text for explanation of A, B, C.)

porous rocks. Muraoka (1969) has shown, however, that plastics absorb negligible amounts of water even after being submerged for a number of years. *Martesia* would be incapable of forcing water into a tunnel heading in plastic. It must be considered therefore that this action is not a prerequisite for active tunnelling in this species.

4. Finally, it has been suggested (Board, 1970) that softening of the surface of the wood by bacteria or fungi may be a prerequisite for larval settlement and tunnelling in *Teredo*. Such a statement could also apply to *Martesia* tunnelling into wood, especially since Pacitti (1964) has reported that smooth or waxy surfaces are less susceptible to attack by pholads. This pre-softening is not necessary for *Martesia* since the polyvinyl piping attacked by *Martesia* in Hong Kong had not been softened by micro-organisms and still retained its polish even after 3 years submergence.

It would seem that *Martesia striata* is capable of direct unaided tunnelling into polyvinyl chloride, a substance hitherto regarded as virtually indestructable by natural means. In wood or rock tunnelling can be envisaged as the rasping of individual fibres or particles from their neighbours. Tunnelling into plastics, however, must be more difficult, since there are no individual particles to dislodge. That *Martesia* can do this is a remarkable attestation to the boring efficiency of the animal. The ability of pholads in general, and *Martesia* in particular, to bore into plastics raises possible doubts as to whether these substances will ultimately prove to be the successors of more conventional materials utilised in the marine environment. Conversely, however, unwanted plastic in the sea may have found some nihilists.

LITERATURE CITED. — ANNANDALE, N. 1924. Bivalve molluscs injuring brickwork in the Calcutta docks. *Rep. Comm. Inst. civil Engineers.*, 4: 60-61. — BALASUBRAMANYAN, R. 1965. A new record on the unusual boring activity of the pholadid *Martesia* in the port of Cochin. *Sci. Cult.*, 31: 155-156. — BOARD, P. A. 1970. Some observations on the tunnelling of shipworms. *J. Zool., Lond.*, 161: 193-201. — CONNOLLY, R. A., DECOSTE, J. B. & GAUPP, H. L., 1970. Marine exposure of polymeric materials and cables after fifteen years. *J. Materials*, 5: 339-362. — EVANS, J. W. 1968. A theoretical consideration of crowding and its effects on the biology of the rock-boring clam, *Penitella penita*. *2nd International Congress on Marine Corrosion and Fouling, Athens (Greece)*, p 1-7. — McGLASHAN, J. 1924. Calcutta. Damage to brickwork by bivalve molluscs. *Rep. Comm. Inst. civil Engineers*, 4: 59-60. — MURAOKA, J. S. 1968. Effects of marine organism. *Machine Design*, p 184-187. — MURAOKA, J. S. 1969. *Materials performance and the deep sea, ASTM STP* 445. Amer. Soc. Test. & Materials, p 5-19. — PACITTI, J. 1964. *Effect of immersion in sea water on rubbers and plastics*. Rubber & Plastics Res. Assoc. Gr. Brit., Information circ. No. 471, p 1-25.

* * * * * * *

BRIAN MORTON, *Department of Zoology, University of Hong Kong.*

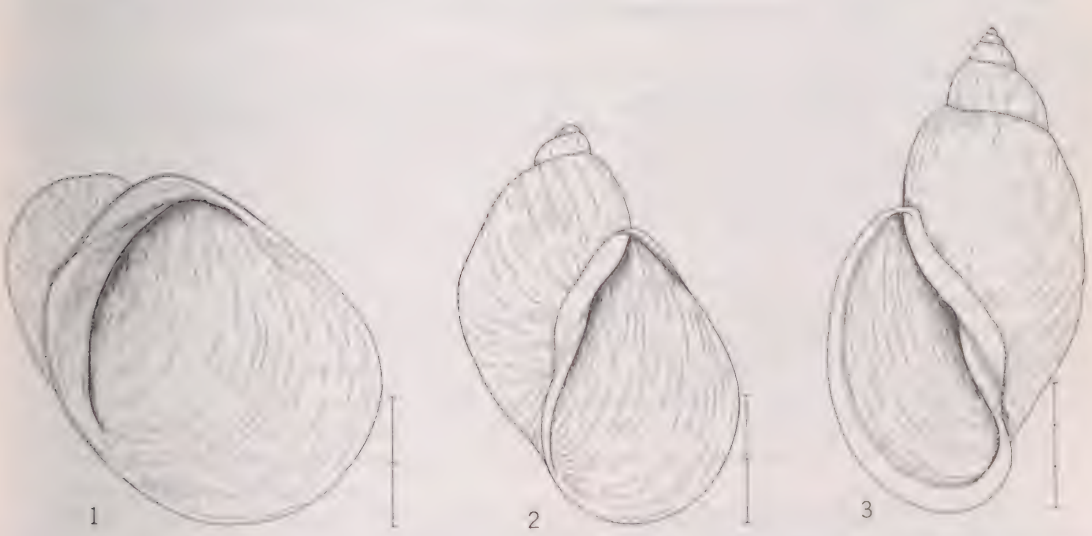
* * * * * * *

CHROMOSOME NUMBERS OF HAWAIIAN LYMNAEIDAE.[1][2] — Although species of the freshwater basommatophoran family Lymnaeidae occur on only very few islands of the Pacific Ocean, the Hawaiian islands have an exceptional fauna. At least 4 endemic lymnaeid species occur there, and several represent conchological oddities of the family: e.g., the neritiform *Erinna newcombi*, adapted to rushing water torrents of falls, and *Pseudisidora producta*, the only sinistral species in an otherwise dextral family.

A question raised by island zoogeographers is, "From where did the original colonizers come?" Or, in relation to present faunas, "To which extant species are the Hawaiian lymnaeids most closely related?"

Chromosome numbers of Hawaiian Lymnaeidae have some bearing on the latter question, because of the known characteristics of lymnaeid chromosomes: (1) they are extremely conservative in regard to chromosome number change, and (2) the Australasian and Far Eastern lymnaeid groups have the chromosome numbers n=16 (2n=32) [in *Austropeplea*] and n=17 (2n=34) [in *Radix*], while the various North American genera all have the numbers n=18 (2n=36)[3]. With this in mind, it was especially pertinent to determine the chromosome numbers of Hawaiian lymnaeids.

During the past several years we have been able to collect 3 species of Hawaiian Lymnaeidae and to determine their chromosome numbers[4]. These species and their localities are as follows: *Erinna newcombi* H. & A. Adams, Hanakapiai Falls, Kauai Island (Fig. 1); *E. aulacospira* Ancey, 3 localities on Kauai Island: (Hanakapiai Falls,; Wainiha River, near Wainiha; small tributary of Waimea River, Waimea Canyon State Park (Fig. 2)); *Pseudisidora producta* Mighels, small stream on Kalalau Trail, between Haena and Kalalau, Kauai Island (Fig. 3).



FIGS. 1-3. Shells of 3 species of Hawaiian Lymnaeidae. Fig. 1. *Erinna newcombi*. Fig. 2. *E. aulacospira*. Fig. 3. *Pseudisidora producta*. Measurement lines in mm.

All 3 species have 18 pairs of chromosomes (n=18), as seen from acetic orcein squashes. Therefore, as based on evidence from chromosome numbers, the Hawaiian lymnaeids would clearly seem to be related to species on the eastern rim of the Pacific (the Western Hemisphere), rather than to those of the western rim (the Far East and Australasia).

Recent references reviewing chromosomes of the Lymnaeidae, of Pacific gastropods, and of mollusks in general are Inaba (1969), Burch (1967), and Patterson (1969). Hawaiian Lymnaeidae have recently been discussed by Burch (1968) and Morrison (1968).

LITERATURE CITED. — BURCH, J. B. 1960. Chromosome studies of aquatic pulmonate snails. *Nucleus*, 3(2): 177-208. — BURCH, J. B. 1967. Cytological relationships of some Pacific gastropods. *Venus*, 25 (3/4): 118-135. — BURCH, J. B. 1968. *Erinna newcombi* of Hawaii and *Limnaea onychia* of Japan. *Malacol. Rev.*, 1: 15-30. — BURCH, J. B., WILLIAMS, J. E., HISHINUMA, Y. & NATARAJAN, R. 1964. Chromosomes of some Japanese freshwater snails (Basommatophora: Branchiopulmonata). *Malacologia*, 1(3): 403-415. — GOULD, A. A., 1848, *"Limnea volutata". Proc. Bost. Soc. natur. Hist.*, 2: 211. — HUBENDICK, B. 1951. Recent Lymnaeidae; their variation, morphology, taxonomy, nomenclature, and distribution. *Kungl. svenska Vet.-akad. Handl.*, ser. 4, 3(1): 1-223. — HUBENDICK, B. 1952. Hawaiian Lymnaeidae.

Occ. Paps. Bernice P. Bishop Mus., 20(19): 307-328. — INABA, A. 1969. Cytotaxonomic studies of lymnaeid snails. *Malacologia*, 7(2/3): 143-168. — ITAGAKI, H. 1956. Anatomy of *Lymnaea* (*Fossaria*) *truncatula* (Müller) from Japan with the comparison with the European material. *Venus*, 19(1): 25-42. — MORRISON, J. P. E. 1968. Notes on Hawaiian Lymnaeidae. *Malacol. Rev.*, 1: 31-33. — PATTERSON, C. M. 1969. Chromosomes of mollusks. *Proc. Symp. Moll.*, Mar. biol. Assoc. India, 2: 635-686.

* * * * * * *

J. B. BURCH and C. M. PATTERSON, *Museum and Department of Zoology, The University of Michigan, Ann Arbor, Michigan* 48104, *U. S. A.*

(1) Supported by research grant GB-6450 from the National Science Foundation, Washington, D. C., and Training Grant 5 T1 AI 41 from the National Institute of Allergy and Infectious Diseases, U. S. Public Health Service.

(2) Grateful acknowledgement is made to Dr. and Mrs. Yoshio Kondo for the assistance (financial and otherwise) which made our Hawaiian collecting possible, and for many other very kind favors.

(3) *Fossaria truncatula* in Japan has 18 pairs of chromosomes (Burch, et al. 1964), but this is an introduced species from Europe (Itagaki, 1956). *Radix auricularia* in North America has 17 pairs of chromosomes, but it is also an introduced European species. The North American *Fossaria modicella rustica* has 19 pairs of chromosomes (Burch, 1960; Inaba, 1969), but other species of *Fossaria* have 18 pairs.

(4) Chromosome numbers of 2 other species occurring in Hawaii have been determined, *Austropeplea ollula* (=*Lymnaea volutata* Hubendick 1951, 1952, not *Limnea volutata* Gould 1848) and *Pseudosuccinea columella*, both introduced. *A. ollula* has 16 pairs of chromosomes, and *P. columella* has 18 pairs.

* * * * * * *

Malacological Review, 1971, 4: 211-212

H. B. HERRINGTON HONORED FOR HIS SPHAERIID WORK. — On 28 May 1971, Rev. H. B. Herrington of Westbrook, Ontario, Canada, received the Degree of *Doctor of Science, honoris causa*, from Waterloo University in recognition for his outstanding studies on North American Sphaeriidae. Dr. Herrington's citation, presented at the Twenty-Second Convocation of the University, read as follows:

"The advancement of our knowledge of the natural world calls upon the resources of many workers of diverse backgrounds. Natural science advanced in the early years mainly through the efforts of persons with little or no formal scientific training. Through the many decades since, scientific discovery and advances in knowledge have become almost exclusively the preserve of the specialist with many years of training in a particular discipline. Thus, to find that the recognized authority on a common group of clams is an amateur, is somewhat remarkable.

"The clams of the family Sphaeriidae have long been a perplexing group to zoologists. They are found throughout the world in almost any freshwater body, from the depths of the Great Lakes to tundra ponds and from mighty rivers to sprightly streams. They are often so abundant as to be the principal diet of some fishes, and hence of interest to the fishery scientist. Shells of Sphaeriidae are common fossils, and the paleontologist trying to reconstruct an ancient habitat or to date a fossil deposit can gain valuable or unique information from them.

"Despite the abundance and economic value of these animals, there was no reliable means of identification. The variation from one habitat to another, the subtle differences between supposed species, and a common lack of illustrated species descriptions, combined to inhibit study of these animals. However, about 1940 these little clams began to get the attention that was needed to increase and to systemize man's knowledge of them. The Reverend Harry Herrington, as a hobby, began to study molluscs in 1937 and later specialized on the Sphaeriidae. In 1958, he retired from the United Church of Canada after 44 years of service in 10 pastoral charges and his hobby became his full-time devotion. His activities included extensive personal collecting of specimens, examination of type material, study of entire sphaeriid collections in several museums, providing identifications of material for museums and researchers in many institutions, and comparison of North American species with those from other regions. His researches led to numerous publications and among them the monograph *A Revision of the Sphaeriidae of North America** made order out of chaos and became a landmark in freshwater malacology.

"Thanks to Reverend Herrington, the zoologist, ecologist, paleontologist, or geologist now has a reasonable chance to identify sphaeriid clams and, building on that foundation, can investigate other problems. Recognition of his expertise is acknowledged by the constant flow of material to Reverend Herrington for identification from numerous workers near and far. Further, the Canadian Society of Zoologists has made him one of its very few honorary members.

"It is hoped that other amateurs will volunteer their interest and ability to shed light on other neglected areas of natural science. May Reverend Herrington's achievements be a source of inspiration and an incentive to them.

"Mr. Chancellor, in recognition of his achievements in the taxonomy of the Sphaeriidae, I request that you confer the Degree of *Doctor of Science, honoris causa*, upon Harry Biggar Herrington."

**Misc. Publs. Mus. Zool., Univ. Mich., No. 118, 74 p, 7 pls., 1962.*

Reverend H. B. Herrington on sphaeriid expedition to central Ontario, Canada, 1960.

MEETING NOTICES

* * * * * * *

SYMPOSIUM ON INDIAN ESTUARINE BIOLOGY. - The Second All-India Symposium on Estuarine Biology will be held at the Centre of Advanced Study in Marine Biology, Porto Novo, on 20-24 January, 1972. Contributions are invited from intending participants in the following fields: hydrobiology of estuaries and backwaters, biology of estuarine animal communities, estuarine ecology and pollution, physiology and biochemistry of estuarine organisms, estuarine productivity, food and fisheries, and estuarine microbiology. Papers presented at the Symposium in person will be published as a special number by the Centre. Those interested should contact the convenor, Prof. R. Natarajan, Centre of Advanced Study in Marine Biology, Porto Novo, Tamil Nadu, India.

THE ISRAEL MALACOLOGICAL SOCIETY, SECOND ANNUAL SYMPOSIUM. - The Second Annual Symposium of the Israel Malacological Society will be held in April 1972. Papers are invited on all aspects of the molluscan fauna of the Near East, i.e. Eastern Mediterranean, Red Sea and adjacent area. Papers should be original and prepared for full publication with an abstract of about 300 words in English. All accepted papers will be published as *Proceedings of the Second Annual Symposium of the Israel Malacological Society*.

The Proceedings of the First Annual Symposium held in Tel-Aviv on April 11th, 1971 are due to appear as a separate issue of the Israel Journal of Zoology. Abstracts of all papers presented at that Symposium are published in Vol. 2, No. 1-2 of *Argamon*, the Journal of the Israel Malacological Society.

SOCIÉTÉ FRANÇAISE DE MALACOLOGIE, CONGRESS AT BESANÇON IN 1972. — The Council of the Société Française de Malacologie, at its session of 15 May 1971, decided to hold a congress at the beginning of June in Besançon, France, and suggested that a symposium on the shell and sclerified parts of mollusks might be held simultaneously. Interested parties should contact the Society in care of the Laboratory de Biologie marine et de Malacologie, 55, Rue de Buffon, Paris Ve, France.

WESTERN SOCIETY OF MALACOLOGISTS. - The fifth annual meeting of the Western Society of Malacologists will be held at Redlands University, Redlands, California June 18 to June 22, 1972. Symposia on Pelecypoda led by Dr. Vida Kenk and on Opisthobranchs led by Mr. Wesley Farmer and papers on other malacological topics will be presented.

Inquiries may be sent to the Secretary, Mrs. Edith Abbott, 1264 W. Cienega Ave., San Dimas, California 91773, U.S.A. Applications for membership in the society should be sent to the Tresurer, Mr. Ralph O. Fox, Department of Invertebrate Zoology, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118. Dues are $2.50 for Regular Members and $1.00 for students.

Executive Board members for 1972 are: President, Mrs. Beatrice L. Burch; First Vice-President, Dr. James H. McLean; Secretary, Mrs. Edith Abbott; Treasurer, Mr. Ralph O. Fox; Members-at-Large, Mr. Anthony D'Attilio and Mr. Hans Bertsch; the three most recent past Presidents are Dr. William Emerson, Dr. A. Myra Keen and Dr. Eugene V. Coan.

AMERICAN MALACOLOGICAL UNION. — The 38th annual meeting of the American Malacological Union will be held at Galveston, Texas, on July 9-14, with Dr. Arthur S. Merrill presiding. Details of arrangements will be sent to members by way of Newsletters during the coming year. Those interested in the American Malacological Union should contact the Recording Secretary, Mrs. Marian S. Hubbard, 3957 Marlow Court, Seaford, New York 11783, U. S. A.

MOLLUSK SEMINAR AT THE UNIVERSITY OF MICHIGAN, August 1972. — A seminar on Multi-disciplinary Contributions to the Study of Systematics and Evolution of Mollusks will be held at the Museum of Zoology, the University of Michigan, Ann Arbor, Michigan, 48104, U.S.A. during the 1st week of August, 1972. The object of the seminar will be to bring together researchers working toward common ends but using a variety of methods in studying mollusks. Areas covered will be morphology, embryology and development, cytology, genetics, physiology, biochemistry and serology, numerical data processing, and ecology and zoogeography. The seminar will be informal, and will consist of a series of brief presentations by participants followed by brief discussions. More extensive discussions may be arranged in subjects of special interest.

Those wishing to attend or to participate in the seminar should contact the organizer of the symposium, J. B. Burch, Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U. S. A.

MALACOLOGICAL SOCIETIES' NEWS

* * * * * * *

AMERICAN MALACOLOGICAL UNION. - The thirty-seventh annual meeting of the American Malacological Union took place at Cocoa Beach, Florida from July 15 to 19, 1971. Dr. David H. Stansbery of Ohio State University presided as President. The hosts were the Astronaut Trail Shell Club of Florida.

Numerous interesting and valuable papers on malacology and related fields were presented, among them a series of 7 papers in a symposium on Molluscan Aquaculture, with William N. Shaw of the Marine Extension Service of the U.S. Department of Commerce as convener. There was also a workshop on Rare and Endangered Mollusks, as a continuation of the studies which began at the 34th meeting of the American Malacological Union at Marinette, Wisconsin in 1968 and which was published in *Malacologia*, Vol. 10, 1970. Included in these studies was an open forum conducted by Dr. Dolores S. Dundee of Louisiana State University in New Orleans. Mr. Earl B. Baysinger of the Office of Rare and Endangered Species of the U.S. Department of the Interior gave the opening address. In the course of the discussions, some voices were raised in support of the idea that American Malacological Union members be encouraged to restrict drastically their collecting of live specimens, more as an expression of a new attitude toward the environment and nature rather than as an important means of conservation — although that too, some felt, should not be overlooked. In this connection it was decided that the third edition of the American Malacological Union publication *How to collect shells*, when it next appears, will be re-named *How to collect and study mollusks*, with emphasis on conservation and observation of living mollusks either *in situ* or in a tank, rather than the indiscriminate collecting of live specimens.

Three field trips were undertaken: an ocean diving trip for certified divers, a freshwater trip to Lake Washington, and a shore collecting trip to Sebastian Inlet. About 160 members and guests were present at the meeting.

Abstracts, summaries and complete reports of all papers presented, as well as an account of the meeting itself, will appear in the next issue of the *American Malacological Union Bulletin*, formerly called *The American Malacological Union, Inc., Annual Reports*.

The 38th meeting of the American Malacological Union will take place in Galveston, Texas under the presidency of Dr. Arthur S. Merrill of the National Oceanic and Atmospheric Administration, who should be consulted for further details.

MOLLUSK SEMINAR, ANN ARBOR, 6 AUGUST 1971. - A seminar on mollusks was held at the Museum of Zoology, The University of Michigan, Ann Arbor to bring together for open communication people working on mollusks in the Michigan region, and to focus attention on their research problems. The seminar was sponsored by the Mollusk Division of the Museum of Zoology and by the *Society for Experimental and Descriptive Malacology*. Abstracts of papers will be published in Vol. 5, No. 1 of *Malacological Review*. The program for the seminar is given below.

Program

1. Opening remarks, J. B. BURCH
2. Some immediate problems in culturing intermediate host snails, HENRY VAN DER SCHALIE
3. The effect of water quality on laboratory culturing of *Biomphalaria pfeifferi* and *Bulinus globosus*, YUNG-SAN LIANG
4. Seasonal migrations and other movements in Douglas Lake pulmonate snails, PHILIP T. CLAMPITT
5. Feeding behavior of three species of succineid snails, AMY L. SHRADER
6. Malacological research at the Ohio State Museum, DAVID STANSBURY
7. Breeding experiments with *Bulinus tropicus*, SHI-KUEI WU
8. Susceptibility of various *Oncomelania* species and *Pomatiopsis lapidaria* to *Paragonimus westermani* and *P. ohirai*, PHILIP T. LOVERDE
9. A simple macroscopic method of determining crystalline forms of deposited $CaCO_3$ in mollusk shells by infra-red spectral analysis, EDWARD L. COMPERE, Jr.
10. Shell formation and the composition of unionid extrapallial fluid, JAMES E. PIETRZAK
11. The systematic relationship of *"Lymnaea" bulimoides*, GENE K. LINDSAY
12. The succineid genus *Quickia*, C. M. PATTERSON
13. Archaic land snails of the Pacific islands, J. B. BURCH
14. Zoogeography of pulmonate gastropods, GEORGE A. TE
15. Developmental regulation of the trochophore of *Nassarius*, JAMES N. CATHER
16. Of shells and time, AURÈLE LAROCQUE

UNITAS MALACOLOGICA EUROPAEA, FOURTH EUROPEAN MALACOLOGICAL CONGRESS. — The 4th European Malacological Congress was held in Geneva, Switzerland, from 6-11 September 1971. The 1st day was reserved for a meeting of curators in charge of mollusk collections followed by the 5-day general meeting. Seventy-eight papers were presented, which will be published as abstracts or full papers in

MALACOLOGIA. The papers in the order presented are listed below.

Program

O. S. ADEGOKE, Paleocene mollusks from Ewekoro, Southern Nigeria.
G. SPAINK, Phylogenetical investigations in the Neogene Astartidae in the southern North Sea basin.
E. KROLOPP, Faunengeschichtliche Bedeutung der altpleistozänen Mollusken-fauna in Ungarn.
P. E. P. NORTON, The earliest occurrence of *Macoma balthica* (L.) as a fossil in the North Sea deposits.
G. NATTKAMPER, Die Bildung der Molluskenschale.
O. S. ADEGOKE, Mineralogy and biogeochemistry of calcareous operculi and shells of some Gastropods.
J. VOVELLE, Transfert du Calcium à travers l'epithélium du repli operculigère chez *Astrea rugosa* L. (Turbinidae).
L. P. M. TIMMERMANS, Shell regeneration in the pond snail *Lymnaea stagnalis* L.
J. F. DE AZEVEDE & M. SIMOES, Contribution of the biochemical identification of the strains of *Bulinus truncatus* group. I. ...
J. C. BORAY, The role of the relative susceptibility of snails ... in the epidemiology of some helminthic diseases.
B. MORTON, A new theory of feeding and digestion in the filter-feeding Lamellibranchia.
J. CHATFIELD, Some aspects of feeding and growth in pulmonate snails.
P. F. NEWELL, The fine structure of the kidney of two terrestrial snails.
J. M. SKELDING, Renal physiology in terrestrial pulmonates.
H. D. JONES & E. R. TRUEMAN, Recording of the heart rate of molluscs in their natural habitat.
N. N. OSBORNE, Micro-biochemical and physiological studies on an identified serotonergic neuron in the snail.
N. W. RUNHAM, Endocrine control of reproductive tract maturation *Agriolimax reticulatus*.
M. de JONK-BRINK, Histochemical and electron microscope observations on the reproductive tract of *Biomphalaria glabrata* ...
L. FOULQUIER, P. BOVARD & A. Grauby, Fixation du zinc - 65 par *Anodonta cygnea* L.
B. SABELLI, On the Polyplacophora described by Monterosato.
J. A. ALLEN, Functional morphology of the Verticordiidae (Bivalvia).
A. JAYET, Sur quelques Pisidiums haut-alpins.
L. A. de ROOIJ, A systematic revision of the genus *Ervilia* (Mactracea, Mesodesmatidae).
P. J. C. RUSSELL & G. H. PETERSEN, The use of ecological data in the elucidation of some shallow water European *Cardium* species.
G. H. PETERSON & P. J. C. RUSSELL, The nomenclature and classification of some European shallow-water *Cardium* species.
J. B. BURCH, A comparative study of some Polish and American Lymnaeidae: an assessment of phylogenetic characters.
T. E. THOMPSON, Gastropod sperm structure.
F. STARMUHLNER, Die Gattung *Melanopsis* in Neukaledonien.
KO BUN HIAN, A new injection fluid for malacologists.
G. WIUM-ANDERSEN, Electrophorensis as support for the identification of various African *Biomphalaria*
A. BEBBINGTON & T. E. THOMPSON, Opisthobranch radulae.
L. SCHMEKEL, Artcharakteristische Feinstrukturen bei Nudibranchiern.
J. P. TARDY, Incidence de la castration sur le tractus genitaleria ponte des Aeolidiidae.
J. E. RIGBY, Anatomy of *Cavolinia inflexa* (Pteropoda).
J. J. OBERLING, Notes on the ornamentation of sea shells.
H. E. COOMANS, Conidae with smooth and granulated shells.
A. H. SCHELTEMA, Radulae of some Chaetodermatidae (Aplacophora, Chaetodermatidea).
A. SOLEM, Convergent evolution in pulmonate radulae
F. GIUSTI, The minute structure of the glochidium of *Unio* and *Anodonta*.
J. J. PARODIZ, The species complex of *Diplodon delodontus* (Lam.).
C. PETTITT, Studies on *Littorina saxatilis* (Olivi).
E. GITTENBERGER, Die Formen von *Abida secale* (Draparnaud) in den östlichen Pyrenaën.
M. A. GUERRUCCI, Le polymorphisme de la couleur du péristome chez *Cepaea hortensis* (Helicidae) en France.
C. B. GOODHART, Small-scale area effects in *Cepaea nemoralis*.
M. A. REX, On the possibility of adaptive polymorphism in *Liguus fasciatus* (Pulmonata; Bulimulidae).
F. S. BARBOSA, Possible competitive displacement and evidence of hybridization between two brazilian species of planorbid snails.
J. F. PEAKE, Interactions between closely related species of terrestrial molluscs.
J. JOOSE & E. S. VELD, The influence of low temperature on the reproduction of *Lymnaea stagnalis* and ... gametogenesis.
P. PARENZAN, La *Mitra zonata* Marryat, del fondo a *Peyssonellia polymorpha* (Zan) di Porto Cesareo (Golfo di Tarento, Mare Ionio).
M. SAMPAIO XAVIER, Quelques aspects de la biologie et écologie de la *Lymnaea truncatula* vecteur de la *Fasciola hepatica* ...
E. S. DEMIAN (presented by B. Hubendick), Effect of *Marisa cornuarietis* on ... *Bulinus truncatus* ... in the U.A.R.
D. GODAN, Die ökologischen Grundlagen der Prüfungsmethoden von Molluskiziden.
R. ROBERTSON, Biology of the Architectonicidae.
G. REAL, Ecologie d'un gastéropode Hydrobiidae.
K. KLEEMANN, *Lithophaga lithophaga* L. (Bivalvia) in different limestone.
M. GARCIA, Recherches sur l'échauffement des coquilles de *Cepaea nemoralis* L.
G. IMHOF, Der Einfluss von Temperatur und Photoperiode auf den Lebenszyklus einiger Süsswasserpulmonaten.
J. F. PRINSLOO & J. A. VAN EEDEN, The influence of temperature on ... *Bulinus tropicus* ... and *Lymnaea natalensis* ...
H. VAN DER SCHALIE & E. G. BERRY, The role of temperature in the ecology and distribution of the snail, *Lymnaea stagnalis*.
A. McDONALD, Activity patterns of *Lymnaea stagnalis* (L.) in relation to temperature conditions: a preliminary study.
H. ANT, Vorschläge zur Erfassung der mitteleuropäischen Mollusken.
R. A. D. CAMERON, Some woodland mollusc faunas from southern England.
K. BABA, Wasservollusken-Zönosen in den Moorwäldern (*Alnion glutinosae* (Malcuit)) der Ungarischen Tiefebene.
J. HEATH, The European invertebrate survey.
P. PANETTA, Les mollusques bathyals du golfe de Tarante.
I. VALOVIRTA, The distribution of the land molluscs in the upheaval area in the Quarken, an archipelago in the Gulf of Bothnia.
J. P. E. MORRISON, Zoogeography of the pleurocerine freshwater snails.
A. C. van BRUGGEN, Distribution patterns of the genus *Gulella* (Gastropoda Pulmonata: Streptaxidae) in Southern Africa.
A. R. MEAD, A prognosis in the spread of the giant african snail to continental United States.
A. SOLEM, Island size and species diversity in Pacific island land Mollusca.
A. H. SCHELTEMA, Eastward and westward dispersal of tropical prosobranch larvae across the mid-Atlantic barrier.
J. EDMUNDS & M. EDMUNDS, Preliminary report on the Mollusca of the benthic communities of Tema, Ghana.
B. SALVAT, Mollusques des îles Tubaui (Australes, Polynésie): comparaison avec les îles de la Société et des Tuamotu.
J. KNUDSEN, Some aspects of the distribution of the marine molluscs of West Africa.
B. J. SMITH, Problems of generic placement in Australian land molluscs.
L. CHAIX, Quelques cas de diphyoidie observés sur des mollusques continentaux.
R. W. DEXTER, Historical aspects of Alpheus Hyatt's work on fossil cephalopods.
F. H. SOETERS, Die Gattung *Bythinella*, insbesondere deren pyrgulide Vertreter, und die Gattung *Marstoniopsis* in Westeuropa.

ANNOUNCEMENTS

* * * * * * *

VOLUMES, ISSUES AND PUBLICATION DATES OF *MALACOLOGICAL REVIEW*. - *Malacological Review* was first published in one number for the year 1968. This single issue (187 pages) constituted Volume 1. During each of the years 1969 (Volume 2) and 1970 (Volume 3) two semiannual numbers were published, each two issues for a calendar year constituting a volume. Hereafter we intend to continue publishing two issues a year, each formally designated as a "number". The first issue of each volume henceforth will be "Vol.__, No. 1" and the second issue "Vol.__, No. 2". Occasionally, both issues for a calendar year may be combined and designated as "Vol.__, No. 1-2". Each volume will normally consist of about 200 pages, although this may vary from time to time.

Publication dates of past issues are as follows: Vol. 1, 7 June 1969; Vol. 2 [No. 1], pages 1-102, 10 June 1969; Vol. 2[No. 2], pages 103-214, 8 May 1970; Vol. 3 [No. 1], pages 1-102, 28 May 1970; Vol. 4, No. 1, 27 July 1971.

DELAY IN MAILING *MALACOLOGICAL REVIEW*, Vol. 3, second part [No. 2] (for 1970), pages 103-192. Increased publication costs in the U. S. A. have caused the editors to investigate possibilities of publishing in other countries where printing is less expensive. After extensive investigation and careful consideration, we decided to publish a number of the journal in India. Unfortunately, that decision has resulted in considerable delay in mailing the second part of Volume 3, for which we apologize to our authors and subscribers.

The manuscripts for Vol. 3 (2nd part) were delivered in India in person by the Editor in April, 1970. The journal was finally printed in early 1971, but could not be transmitted through the Indian post without permission of the Indian government (Registrar of Books and Newspapers). Although application for this permission was submitted through the Chief Presiding Magistrate in Madras in 1970, followed by repeated inquiries, permission has not yet been granted by the responsible authorities. We therefore beg our subscribers to be patient. If Vol. 3 (2nd part) is not mailed by 31 January 1972, we intend to print that number in Ann Arbor.

NEW SUBSCRIPTION PRICE FOR *MALACOLOGICAL REVIEW*. - Beginning with Volume 5 (1972) the subscription price for institutional orders coming directly from North American institutions (i.e., not through a subscription agency), as well as for all foreign institutions and foreign institutional subscriptions through agencies, will be increased from US$ 5.00 to US$ 8.00 (A$ 7.15, Rs. 60.00, ¥ 2560, E£ 3.5). North American institutional subscriptions handled through subscription agencies will be US$ 9.00 (due to the extra handling required in processing orders). Subscription price for private individuals will remain the same for North American subscribers (US$ 5.00), but subscriptions for non-North American private subscribers will be increased to US$ 5.50 (A$ 4.90, Rs. 42.00, ¥ 1760, E£ 2.5) to defray postage costs.

LIST OF EUROPEAN MALACOLOGISTS, by Oliver E. Paget, Vienna. This booklet contains an alphabetical list, with addresses, of more than 900 European malacologists, and for about 275 of them an additional list with their special fields of interest, whether or not they maintain private collections, and if they are willing to make identifications for others. This second list was compiled from questionnaires sent to the 900+ malacologists in December, 1970, as commissioned by the Unitas Malacologica Europaea. Copies of this publication may be obtained from Dr. O. E. Paget, Museum of Natural History, Burgring 7, A-1014, Vienna, Austria. Price: 5 International Reply Coupons (available at any postoffice), A.S. (Austrian Shillings) 20.-, US$ 1.00, £ 0.40. Payment may be sent directly to Dr. Paget, or to Creditanstalt-Bankverein bab 43-24349, Babenbergerstrasse, A-1010, Vienna, Austria.

GRADUATE STUDY IN MALACOLOGY AT THE UNIVERSITY OF MICHIGAN. - National Institutes of Health Predoctoral Traineeships in malacology are available at the Museum and Department of Zoology, The University of Michigan, to qualified U.S. citizens. Participants are expected to pursue graduate studies leading to the Doctor of Philosophy (Ph.D.) degree in Zoology. Active research programs dealing with mollusks include cytology, cytogenetics, cytotaxonomy, genetics, cell, tissue and organ culture, developmental biology, comparative physiology and biochemistry, systematics, natural history, ecology, zoogeography, parasitology and medical zoology. Special emphasis is placed on freshwater mollusks, although aspects of land and marine malacology are also considered. Facilities include well-equipped modern research laboratories for various aspects of biological research. First year stipends are US$ 2400 plus tuition, plus a US$ 500 allowance for each dependent. Address inquiries to the Mollusk Division, Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U.S.A.

BOOK REVIEWS

* * * * * * *

BIOLOGY OF INTERTIDAL ANIMALS, R. C. NEWELL. American Elsevier Publishing Company, Inc., New York, 1970. 555 p. US $ 23.75.

This volume is worthy of study by all who are interested in marine animals, because the author has shared his insight into the ways organisms adapt to the edge of the sea. Unfortunately, few will have the opportunity to own a copy due to the cost. It is difficult to determine the reason for such a price, since there are no photographs and the paper and binding are not of the best quality. However, there are many graphs and a considerable number of tables and line drawings which have been well executed and clearly reproduced. The text contains remarkably few production errors and the author and subject indexes are thorough.

The author's aim is to establish the physiological basis for the distribution of intertidal animals. In those aspects covered, he is remarkably successful. Each of the major topics comprises 2 chapters, with the exception of the final one on thermal stress and dessication. Each chapter has a short introduction which poses the problems to be discussed and points out the significance of the particular viewpoint which follows. These introductory statements are thoughtful and reflect the author's wide experience; they also serve as the major source of integration through the book.

The 1st chapters are brief, considering the author's attempt to deal with the physical, chemical and biological constitution of the intertidal zone. Through his concise writing style and excellent integrative abilities, the author has probably produced the best short introduction to the nature of the fringe of the sea presently available.

The 2nd pair of chapters consider the establishment and maintenance of the zonation patterns described in the previous chapters by the factors which control larval settlement in a number of species representing an array of phyla. The role of behavior in spacing the settled forms and in relation to the physical and biological aspects of the environment are dealt with in a rather superficial fashion, which is surprising considering the authors expertise in this area.

The following chapters deal with the mechanisms of feeding and the factors which affect feeding, and is a clear and comprehensive presentation of the major food gathering techniques used by invertebrates. More than half the examples are molluscs, which show great diversity in their feeding, and for which there is an extensive literature. That the factors which affect feeding are not well known is indicated by the few pages relegated to this topic. The origin, distribution and variation in organic materials in the substrate utilized by deposit feeders is thoroughly discussed and allows one to understand how such animals can dominate the fauna of certain habitats.

The final 2 chapters deal with respiratory mechanisms and the factors which affect the rate of oxygen consumption. The material is precisely and logically presented and covers the uptake of oxygen from sea water, the mechanisms of gas exchange in different animals and the diversity and role of respiratory pig-

ments. There is a good discussion of anaerobiosis in intertidal animals. Such routinely considered factors which affect the rate of oxygen consumption as body size and activity are discussed, but the interrelationship of environmental factors such as salinity, photoperiod and temperature, which may serve as controlling factors in respiration, are also examined. A short section on oxygen as a limiting factor concludes the discussion.

The final chapter considers the effect of temperature on the intertidal fauna and the physiological and behavioral specializations which allow animals to survive long periods of dessication when the tide is out.

The major omissions are the lack of consideration of the ionic and osmotic problems faced by intertidal invertebrates which reduces the comprehensive nature of the review and a concluding chapter could serve to better integrate the physiological adaptations which are detailed, relative to the intertidal environment. The non-physiological aspects of ecology are inadequately covered so that many of the complex relationships of the intertidal community are ignored. A few good photographs of intertidal zones for non-specialists or students unfamiliar with the sea shore would have been desirable. It would also have been helpful to place the chapter on thermal stress and dessication after the 2nd chapter while the zonation patterns are still fresh in the readers mind, especially since these problems are unique to the intertidal zone in the marine environment, while consideration of feeding and respiration can be more generally applied to marine animals.

The discussion of respiration takes up more than 1/3 of the book and I suspect requires the reader to have a better background in physiology than the other chapters which are more nearly autonomous. The author does include a short review of the biochemistry of respiration and anaerobiosis, but this is too brief for those unfamiliar with the processes and of little value to those who are. Possibly, the major weakness is the absence of critical evaluation of the methods used, some of which are not very rigorous, in obtaining the data presented.

In spite of these weaknesses, the consistently high quality of the overall presentation and the depth and breadth within each chapter, along with the utilization of many molluscan examples, make this book one which should be studied by all malacologists interested in marine forms.

JAMES N. CATHER

Department of Zoology
University of Michigan
Ann Arbor, Michigan 48103, U.S.A.

THE SYSTEMATICS AND BIOLOGY OF ABYSSAL AND HADAL BIVALVIA. KNUDSEN, JORGEN. Danish Science Press, Ltd., 1970. 241 p, 20 pls., 12 tables, 132 figs. Separately paged and reprinted from *Galathea Report*, Vol. 11. 120 Danish Kroner.

One hundred years ago naturalists contended that the great expanse of the deep-sea was devoid of life or that the mysterious depths harboured the *Urschleim*, a primordial protoplasm displaced by the higher organisms to the unknown dark abyss. The subsequent startling discovery that diverse animals populated the depths - and even an *Urschleim* was described, *Bathybius haeckelii* Huxley, generated an undying interest in the exploration of the deep-sea. Nation after nation, emulating a standard established by the *Challenger* Expedition, sought to enlarge man's knowledge of the deep, and no nation has been more successful and more important than Denmark and its unusually talented and productive marine biologists.

In his monograph, Jorgen Knudsen has far outdistanced specific discussion of any group of molluscan inhabitants of the abyssal and hadal zones. These zones are defined as: abyssal, being between depths of 2000-6000 m with water less than 4°C; and hadal, depths greater than 6000 m and thereby including all the trenches. Although the material reviewed was collected by the Danish *Galathea* Expedition of 1950-52, the author has searched out and observed most of the samples taken by some 28 deep-sea expeditions. In the systematic section, the 91 species collected by the *Galathea* are treated, including the description of 44 new species. Excellent line drawings and half-tone photographs accompany the descriptive text. Knudsen has incorporated anatomical features, which aid in identification, and measurements, which indicate intraspecific variation in shell form. Species are contrasted with related forms and introductory remarks are provided for the various families.

From off East Africa in nearly 5000 m comes the new family Galatheavalvidae, based on *Galatheavalva holothuriae*, a species which lives commensally in cavities at the oral end of an undescribed species of the holothurian, *Psychropotes*. Although the author does not assign the family a place in the bivalve classificatory scheme, I venture that it may be related to the Erycinacea. The commensal relationship is similar to species of *Entovalva* and *Cycladoconcha* which also live in various associations with holothurians; the fact that the shell is completely enclosed by the mantle recalls another erycinacean, *Chlamydoconcha*, from California. Though these broad and behavioural characters may be convergent, anatomical features, including the small palps, partially plantar foot, well developed byssus and single gill, marshall stronger evidence. Further, the hinge simplification, the gonochoristic condition with incubatory females, and the elongate, ventrally displaced anterior adductor muscle also point to erycinacean affinities.

The singularly most striking feature about the deep-sea Bivalvia is our lack of knowledge: of the 193 known species, 65% have been recorded only once and 86% three times or less. Nevertheless, Knudsen has brought together information on all known forms and has formed certain important generalizations. The makeup of the fauna differs sharply from more shallow bathyal or even sublittoral waters. Of some 80 modern families of bivalves, only 20 are found in the abyss. The nonheterodont families, protobranchs and septibranchs, predominate.

The pertinent literature concerning the antiquity and constitution of the deep-sea fauna is ably and extensively reviewed by the author and all of the geological ages of the families and genera tabulated; it is concluded, as has been suggested

by others, that there has been a more or less continuous descent of shallow water organisms. However, to me it is quite obvious that the successful radiation of the heterodont, eulamellibranch lineages in the late Mesozoic displaced the older protobranch-septibranch lineages which recently have been shown to be anatomically related. Whether the fauna is ancient, i.e. of Paleozoic affinities, is less important than the recognition that it is composed of older elements than the shallow water fauna and, as the geological record indicates, it was largely derived during and since the late Mesozoic. Knudsen shows that little similarity remains between the bivalve fauna of the Arctic-Antarctic and the abyss, an observation which lends credence to some suppositions on the age and source of the fauna.

Zoogeography commands universal interest among marine biologists and the distribution of abyssal organisms is a subject which has generated considerable debate. Two opposing schools can be identified: the cosmopolitanist and the endemicist, which can be likened to the lumpers and the splitters of taxonomy. Knudsen points out that true cosmopolitanism among bivalves and other abyssal organisms is rare, but his rendering of cosmopolitan, *i.e.*, world wide, in all abyssal faunas, is constricting. Near cosmopolitanism, or widespread distributions are, on the other hand, supported by considerable evidence.

Eurybathy correlates with cosmopolitanism, and, what is more important, both are related to how well known species are, *i.e.*, number of samples. The correctness of the observed relationship is supported by systematic studies which have treated particular animal groups on a world-wide basis. Pennatularians by Kükenthal and Broch, asteroids by Madsen, holothurians by Hansen, scyphozoans by Kramp, all show wide-spread distributions, while those studies which support restrictedness are in themselves usually restricted in geographical scope.

The author hints that near cosmopolitanism is quite probably the rule among the Bivalvia, but since no family or genus of abyssal mollusks, along with its shallower congeners, has been monographed systematically, we must await more concrete evidence. This work establishes a touchstone for further studies, including revisions of individual taxa, and will act as a guiding beacon for future research.

Jorgen Knudsen is to be congratulated for an outstanding addition to our knowledge of deep-sea organisms.

KENNETH J. BOSS

Museum of Comparative Zoology
Harvard University
Cambridge, Massachusetts 02138, U.S.A.

SUPERFAMILIA UNIONACEA. FRITZ HAAS. *In: Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen*. Lief. 88: i-x, 1-663. W. de Gruyter & Co., Berlin, 1969a.

SUPERFAMILY UNIONACEA. FRITZ HAAS. *In: Treatise on Invertebrate Paleontology* (R. C. Moore, ed.). Part N. Mollusca, 6; vol. 1 (of 3): Bivalvia. Univ. Kansas Press, Lawrence, 1969b. [Unionacea: p 411-470.]

The former work has been previously reviewed (see *Basteria*, 34: 58-60; *Veliger*, 12: 381, 1970), but a few more remarks seem appropriate, especially when that volume is compared to the same author's treatment of unionacean naiades in the latter publication.

The scope of the 2 works is essentially different. The 1969a book includes all of the world's unionacean (and mutelacean!) mussels, including species and subspecies, and is the most complete effort of its kind since Simpson (1914). The abridged classification in the *Treatise* is only through subgenera, but it is the most recent work of its type since Ortmann (1914) and Thiele (1935). Both works are more taxonomic (i.e., nomenclatural) than systematic (i.e., phylogenetic) in nature, and each lists type genera and type species. However, only in the *Treatise* is the mode of type designation indicated, i.e., by monotypy, original designation or subsequent designation. Type localities for species and subspecies are listed only in *Das Tierreich*. Although both publications cite general geographical ranges, only the *Treatise* treatment has incorporated the age and place of fossil occurences.

The format in the 2 publications is very largely conchological, and a diagnosis/description of the shell characters of all taxa is provided in each. Synonymies for only some generic-group taxa but all species and subspecies are included in *Das Tierreich*, while they are listed for just some genera and subgenera in the *Treatise*. All subfamilial and some generic-group synonyms were omitted from both works, perhaps purposefully considering the excessive numbers of such names erected by Modell (1942, 1949, 1964). While the taxa listed in the *Treatise* bear only the author's name and date of publication, those in *Das Tierreich* have in addition an abbreviated indication of the original reference, page, plate and figure number.

Employing shell characters only, some identification keys are provided just in *Das Tierreich*. However, there is no key to families, and in the Unionidae [*sensu lato*] there are keys to the genera only in the Unioninae s.s, Quadrulinae and Anodontinae (but not Alasmidontinae, Lampsilinae and Hyriinae); nor are there keys to the mutelid [Mutelacea] and "etheriid" genera. Futhermore, not all genera have keys to the included species and subspecies. Nevertheless, keys to unionacean shells have not always proven easy to use, and that is also the case here. For example, in the key to the 58 nominal genera of the Unioninae s.s. one must make a choice in one couplet of "Dünnschalig" or "Dickschalig," a relative character indeed. And this difficulty is faced only after selecting an earlier choice between 5, 5', 5'', 5''', 5'''' and 5'''''.

Illustrations of taxa (viz., type species of the various genera and subgenera) are presented only in the *Treatise*. Most of them seem accurate, but that of *Elliptoideus sloatianus* (Lea) (Fig. D26,2 on p 427) is totally in error; it may represent a shell of *Quincuncina infucata* (Conrad). The illustration of *Quincuncina burkei* Walker (Fig. D36,6a on p 440) is a good one of *Megalonaias boykiniana* (Lea), or it could even pass for a dorsally-arched form of *Elliptoideus sloatianus*. Moreover, the shells of *Elliptoideus sloatianus* and *Megalonaias gigantea* (Barnes) reach much larger sizes than the impressions given by the indicated magnifications.

While both works appeared in 1969, the manuscript for *Das Tierreich* was submitted in 1950 and that for the *Treatise* in 1965. The classification in the 2 efforts are quite similar at the familial, subfamilial, generic and subgeneric levels, although a few changes occurred in this 15-year interval. For example, *Elliptoideus* Frierson ("Unionidae: Unioninae") was originally (1969a) considered to represent a subgenus of *Elliptio* Rafinesque, but was later (1969b) included as a subgenus of *Nephronaias* Crosse & Fischer. In addition, there appear in the 2 publications a few differences that must be resolved by consulting the original papers concerned. For instance, in the Unionidae/Unioninae Haas (1969a: 85) cited the generic name *Unionetta* Haas, 1955 (= new name for *Unionella* Haas, 1913; *non* Etheridge, 1883). Yet in 1969b (p 435) he used the name *Unionea* Haas, 1955 (=*Unionella* Haas, 1913; *non* Etheridge, 1888). *Unio fabagina* Deshayes & Jullien was listed as the type species of both *Unionetta* Haas and *Unionea* Haas. Is *Unionea* a *nomen nullem*, and which is the true date of Etheridge's publication?

The 2 publications reviewed here have their strengths and weaknesses, yet for their intent they largely complement each other. For the most part, both treatments are those of a splitter at the generic and specific levels, but those of a lumper at the subfamilial and familial levels. Nevertheless, the inclusive listings will provide a convenient reference for further work by future taxonomists and systematists.

Other investigators (e.g., Parodiz & Bonetto, 1963; Heard & Guckert, 1971) have demonstrated that classifications of freshwater mussels based on anatomical and reproductive characters do not necessarily coincide with those based on features of the shell. Since the vast majority of unionacean taxa are based on shell characters, Dr. Haas' recent publications represent a compendium of taxonomic information which can be used as a starting point for investigations of the *animals* involved. If considered as hypotheses to be tested, his contributions will provide for interesting future research. Among the many questions that might arise are these: Does *Unio elongatus* Pfeiffer really have as many as the 18 subspecies cited; are at least some not in reality ecophenotypes? Are the 6 species of *Alasmidonta* Say so naturally divergent that they truly must be placed in 5 different subgenera? Are all of the 34 taxa included in *Ligumia* Swainson valid species, and do they all belong to that genus (most workers would place some of them in *Lampsilis* Rafinesque)?

References

HEARD, W. H. & GUCKERT. 1970. A Re-evaluation of the Recent Unionacea (Pelecypoda) of North America. *Malacologia*, 10(2): 333–355.

MODELL, H. 1942. Das natürliche System der Najaden I. *Arch. Molluskenk.*, 74: 161–126.

MODELL, H. 1949. Das natürliche System der Najaden II. *Arch. Molluskenk.*, 78: 29–48.

MODELL, H. 1964. Das natürliche System der Najaden III. *Arch. Molluskenk.*, 93: 71–126.

ORTMANN, A. E. 1919. A monograph of the naiades of Pennsylvania. *Mem. Carnegie Mus.*, 4(6): 1–384.

PARODIZ, J. J. & BONETTO, A. A. 1963. Taxonomy and zoogeographic relationships of the South American naiades (Pelecypoda: Unionacea and Mutelacea). *Malacologia*, 1(2): 179–213.

SIMPSON, C. T. 1914. *Descriptive catalogue of the naiades or pearly freshwater mussels*. Bryant Walker, Detroit, Mich. 1540 p.

THIELE, J. 1934. *Handbuch der Systematischen Weichtierkunde*. Fisher, Jena, 3: 782–948.

W.H. HEARD

Department of Biological Sciences
Florida State University
Tallahassee, Florida 32306, U.S.A.

PLEISTOCENE MOLLUSCA OF OHIO. AURÈLE LA ROCQUE. Ohio Geological Survey, Columbus, Ohio. Part 1 (1966); Part 2 (1967); Part 3 (1968); Part 4 (1970). p 1-111; 112-356; 357-554; 555-800, figs. 1-624, pls. 1-18.

Aurèle La Rocque is to be complimented for the considerable expenditure of time and effort that must have gone into the compilation of this basic reference work. This 4-part treatise published over the years 1966-1970 contains a wealth of information on 444 species and varieties of mollusks. The title *Pleistocene Mollusca of Ohio* is, however, somewhat of a misnomer. A large number of the forms treated in this work are known only from records which indicate that they were living in the state within historic times, but are not known from the Pleistocene of Ohio. Some of the species listed are assumed to occur in Ohio because they have been reported in adjacent states (e.g., *Pisidium milium*); and still others have been included which are not native to North America (e.g., *Limax gracilis*) and have probably been introduced to this continent within the last 150 years.

Part 1, published in 1966, contains 3 chapters, (1) Introduction; (2) Geologic Setting; and (3) Paleoecology. The 1st chapter is a relatively lengthy discussion of the factors responsible for the origin, composition and distribution of the molluscan faunas of the midcontinent region of North America and summarizes the problems involved in the collection, identification and interpretation of Pleistocene assemblages. Chapter 1 provides much useful background information for students of the Pleistocene who may only be peripherally acquainted with the study of nonmarine mollusks.

Chapter 2 is devoted to a brief history of the Pleistocene of Ohio which emphasizes the stratigraphic record of the Mollusca in the state. It would have been useful and appropriate if the stratigraphic distribution data for the mollusks, which are scattered throughout the remaining 3 parts of the monograph, had been summarized in tabular form in this chapter.

The geologic age and paleoecologic interpretation of fossil assemblages is primarily based on analogy with faunas of known age and with communities of living organisms. The 1st part of Chapter 3 introduced the assumptions which are basic to the interpretation of the fossil molluscan assemblages. The remainder of Chapter 3, and by far the longest portion of Part 1, is devoted ostensibly to the presentation of lists of representative living and Pleistocene fossil assemblages from the midcontinent region. The lists are arranged by stratigraphic position and geographic location and include faunas that range in age from the Upper Pliocene of the southern High Plains to the Recent. The Recent assemblages include collections from localities in Manitoba, eastward through the Central Lowland to Quebec and western New York. The assemblages presented in this compilation can hardly be considered representative and in some cases are of questionable value. None of the radiocarbon dated, stratigraphically located faunas from Illinois are included (e.g., Leonard & Frye, 1960), but faunal lists from 14 localities in Missouri of uncertain Pleistocene age are presented in this compilation.

Apparently no effort was made to evaluate the validity of species described by the different workers whose publications provided the basic data for many of the faunal lists. For example, some of the faunas listed for the Kansan glacial stage of Kansas are based on the work of Frye & Leonard (1954), and contain *Gastrocopta procarmifera* and *Carychium perexiguum*. Many of the Pliocene, Nebraskan, Aftonian, Illinoian and Sangamon faunal lists, however, were taken from Taylor (1960) and Hibbard & Taylor (1960). These authors consider the 2 above species as

synonyms of *G. armifera* and *C. exiguum*, respectively. As the result of such circumstances, some of these faunal lists contain spurious species and must be used warily. Two errors in age assignment were noticed in chapter 3: Assemblage S-6 (Sangamon-Kansas), and assemblage Y-1 (Yarmouth-Indiana) should both be listed under the Illinoian Stage.

The remaining 3 parts of this monograph are devoted to a comprehensive taxonomic treatment of the 444 species and varieties which are distributed as follows: part 2 (published in 1967), includes the naiades (107 forms) and sphaeriids (61 forms); part 3 (published in 1968), covers the fresh-water gastropods (144 forms); and part 4 (published in 1970), treats the terrestrial gastropods (132 forms). A brief synonymy, diagnosis, type locality, ecology, maps showing geographic distribution in North America and Ohio, geologic range, remarks and illustrations are provided for most of the 444 forms. None of the figures used to illustrate these shells are new. This is unfortunate, since many of the species, especially among the fresh-water gastropods, are inadequately figured. The quality of the illustrations varies with the condition of the originals from which they were taken.

Pleistocene Mollusca of Ohio is primarily an uncritical compilation of information from the literature; therefore, data taken from this work should be considered in this context. In spite of these limitations this work still deserves a place in the library of anyone interested in the Pleistocene or Recent molluscan fauna of the lower Great Lakes. There are good descriptions for most of the species and adequate illustrations for many of the forms referred to, which should provide an excellent starting point for individuals interested in working with the mollusks of this region.

References

HIBBARD, C.W. & TAYLOR, D.W. 1960. Two late Pleistocene faunas from southwestern Kansas. *Contr. Mus. Paleontol., Univ. Mich.*, 16(1): 1-223.

FRYE, J.C. & LEONARD, A.B. 1954. Significant new exposures of Pleistocene deposits at Kerwin, Phillips County, Kansas. *Kans. geol. Survey Bull.*, 109(3): 33-48.

LEONARD, A.B. & FRYE, J.C. 1960. Wisconsin molluscan faunas of the Illinois Valley Region. *Ill. Geol. Surv. Circ.*, 304: 1-32.

TAYLOR, D.W. 1960. Late Cenozoic molluscan faunas from the High Plains. *U.S. Geol. Surv., Prof. Paps.*, 337: 1-94.

B.B. MILLER

Department of Geology
Kent State University
Kent, Ohio 44240, U.S.A.

Malacological Review, 1971, 4: 225-255

CONTENTS OF MALACOLOGICAL PERIODICALS, 1970
(Continued from Vol. 4, No. 1)

At the time *MALACOLOGICAL REVIEW*, Vol. 4, No. 1 went to press all issues for 1970 of some of the journals had not yet been received at our editorial offices. The tables of contents of these late numbers are included here; they are issues of the journals listed below. The contents of *MALACOLOGICAL REVIEW* are also given in order to complete the list of malacological journals.

Journal	Country[1]	Page[2]
Malacologia	International[3]	226-227
Journal de Conchyliologie	Australia[4]	228
Proceedings of the Malacological Society of London	U.K.[5]	229
Proceedings of the National Shellfisheries Association	U.S.A.[6]	230-233
The American Malacological Union, Inc., Annual Reports	U.S.A.[7]	234-235
Sterkiana	U.S.A.[8]	236-237
Comunicaciones de la Sociedad Malacológica del Uruguay	Uruguay[9]	238
Conchiglie	Italy[10]	239-243
Malacological Review	International[11]	244-245
The Echo	U.S.A.[12]	246-248
La Conchiglia	Italy[13]	249-252
Argamon	Israel[14]	253-255

---

[1]Addresses of editorial offices are given in footnotes 3-14.

[2]Page numbers, this issue of *Malacological Review*.

[3]Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U.S.A.

[4]18/55 Prince Albert St., Mosman, N.S.W. 2088, Australia.

[5]Department of Zoology, The University, Whiteknights, Reading RG6 2AJ, U.K.

[6]National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Marine Extension - Shellfish, Oxford, Maryland 21654, U.S.A.

[7]3957 Marlow Court, Seaford, New York 11783, U.S.A.

[8]102 W. Beaumont Road, Columbus, Ohio 43214, U.S.A.

[9]Casilla de Correo No. 1401, Montevideo, Uruguay.

[10]Via De Sanctis, 73, Milan, Italy.

[11]P.O. Box 801, Whitmore Lake, Michigan 48189, U.S.A.

[12]1217 Waller Street, San Francisco, California 94117, U.S.A.

[13]Piazza S. Lorenzo in Lucina, 35, Rome, Italy.

[14]P.O. Box 9216, Haifa, Israel.

Vol. 10, No. 2 **MALACOLOGIA** December 1970

Editor-in-Chief
J. B. BURCH

Associate Editor
R. NATARAJAN

Managing Editor
C. M. PATTERSON

General Editors
ANNE GISMANN C. J. BAYNE

Business Manager
S. K. WU

EDITORIAL OFFICES

Museum of Zoology
The University of Michigan
Ann Arbor, Mich. 48104, U.S.A.

19, Road 12
Maadi, Egypt
U.A.R.

Marine Biological Station
Porto Novo, Tamil Nadu
India

* * * * * * * * * *

MALACOLOGIA, the international journal of molluscan research, is a multilingual publication dealing with all aspects of the study of mollusks, including morphology, ecology, evolution and fossil record, classification, distribution, physiology, biochemistry, cytology, genetics, parasitism, etc. MALACOLOGIA is published by the Institute of Malacology, 1336 Bird Road, Ann Arbor, Michigan, U.S.A. The Sponsor Members of this Institute, also serving as editors, are listed below.

N. F. SOHL, *President*
R. ROBERTSON, *President-Elect*
J F. ALLEN *Vice-President*
C. R. STASEK, *Secretary*
K. J. BOSS, *Treasurer*

E. G. BERRY
J. B. BURCH
M. R. CARRIKER
G. M. DAVIS
A. G. SMITH

* * * * * * * * * *

Increasing production costs regretfully have necessitated increasing subscription prices. Beginning with Vol. 13 (1972) subscription price per volume for North American institutions will be US $ 15.00 (postpaid), and for all other institutions US $ 12.00 (postpaid) (A$ 11, £ 5, Fr. 60, Rs. 90, E£ 5). Subscription prices (postpaid) for all others and addresses for ordering are listed below. Add $ 1.00 per volume for subscriptions handled by North American subscription agencies (to help offset the added handling expense).

US $ 9.00
MALACOLOGIA
Museum of Zoology
University of Michigan
Ann Arbor, Michigan 48104
U.S.A.

£ 4
MALACOLOGIA
c/o C. J. Duncan
Department of Zoology
University of Liverpool
Liverpool L69 3BX, England

Fr. 45
MALACOLOGIA
c/o E. Fischer-Piette
Mus. Nat. d'Hist. Natur.
55, Rue de Buffon
Paris 5e, France

$ A 8.00
MALACOLOGIA
c/o W. F. Ponder
Australian Museum
6-8 College St.
Sydney, Australia

Rs. 68
MALACOLOGIA
c/o R. Natarajan
Marine Biological Station
Porto Novo
Tamilnadu, India

E£ 4
MALACOLOGIA
c/o E. S. Demian
Department of Zoology
Ain Shams University
Cairo, Egypt, U.A.R.

MALACOLOGIA

Vol. 10, No. 2 December, 1970

CONTENTS

WINTERBOURN, M.
The New Zealand species of *Potamopyrgus* (Gastropoda: Hydrobiidae) 283

McSWEENY, E. S.
Description of the juvenile form of the Antarctic squid *Mesonychoteuthis hamiltoni* Robson 323

HEARD, W. H. and GUCKERT, R. H.
A re-evaluation of the Recent Unionacea (Pelecypoda) of North America 333

GREENE, R. W.
Symbiosis in sacoglossan opisthobranchs: Symbiosis with algal chloroplasts 357

GREENE, R. W.
Symbiosis in sacoglossan opisthobranchs: Translocation of photosynthetic products from chloroplast to host tissue 369

APLEY, M. L.
Field studies on life history, gonadal cycle and reproductive periodicity in *Melampus bidentatus* (Pulmonata: Ellobiidae) 381

McCRAW, B. M.
Aspects of the growth of the snail *Lymnaea palustris* (Müller). 399

JURBERG, P.
The shell structure of *Astraea olfersi* (Gastropoda: Turbinidae). 415

ZISCHKE, J. A., WATABE, N. and WILBUR, K. M.
Studies on shell formation: measurement of growth in the gastropod *Ampullarius glaucus* 423

LLOYD, D. C.
The function of the odour of the Garlic Snail *Oxychilus alliarius* (Pulmonata: Zonitidae) 441

LLOYD, D. C.
The composition of the odour of the Garlic Snail *Oxychilus alliarius* (Pulmonata: Zonitidae) 451

Published by the Institute of Malacology, c/o The University of Michigan, Ann Arbor, Mich. 48104, U.S.A. and Printed by V. Sethuram at Hoe & Co., the 'Premier' Press, 31, Stringers Street, Madras-1, INDIA

JOURNAL
DE
CONCHYLIOLOGIE

Volume CVIII.—No. 2 Paru le 30 juin 1970

Nueva especie de *Pleuromeris* (*Pelecypoda, Carditidae*) obtenida en la costa atlantica de Uruguay, por Miguel A. KLAPPENBACH 35

Une mystification bourguignatienne, par F. LLABADOR 40

Fluorescence de la coquille chez certains Céphalopodes actuels, par P.-H. FISCHER 43

Face interne des coquilles de Mollusques examinée en lumière de Wood, par P.-H. FISCHER 44

Nouvelles: Prochain Congrès de l'*Unitas Malacologica Europaea*, par le Dr. E. BINDER 52

Information: Propositions faites au *Bulletin* of Zoological Nomenclature 54

Bibliographie 55

Vol. CVIII.—No. 3 Paru le 30 septembre 1970

Self-fertilization in the Land Snail Family *Succineidae*, by C. M. PATTERSON 61

Corrosella, n. gen. (Prosobranchia, Hydrobiidae), par Hans D. BOETERS 63

Croissance de la coquille chez *Capulus hungaricus* L., par P.-H. FISCHER 70

Indications malacologiques données dans la Relation d'Antonio Pigafetta, historiographe du Voyage de Magellan, par P.-H. FISCHER 74

Commémoration du Centenaire de Louise FISCHER 78

Nécrologie: Dr. Fritz HAAS et Dr. S. JAECKEL 78

Bibliographie 79

Vol. CVIII. No. 4 Paru le 30 décembre 1970

Les Mollusques d'un dragage industriel en rade de Brest, par Albert LUCAS 87

Sur le régime alimentaire d'*Arion empiricorum* Fér., par P.-H. FISCHER 91

Gastéropodes testacés marins du Golfe de Siam, par P.-H. FISCHER 93

Informations et Nouvelles:
"Argamon", nouveau périodique malacologique 122
Propositions faites au "Bulletin of Zoological Nomenclature" 122
Congrès de Systématique et de Biologie évolutive 122

Nécrologie: F. A. Schilder 123

Bibliographie 124

Table des Matières 131

Table alphabétique 137

Pour toute communication scientifique ou souscription aux volumes en cours, s'adresser à M. P.-H. FISCHER, directeur du Journal, 18/55 Prince Albert Str., Mosman, N.S.W. 2088, Australie.

PROCEEDINGS OF THE

Malacological Society

OF LONDON

VOLUME 39 · PART 2/3 · DECEMBER 1970

CONTENTS

OBITUARY. FRITZ HAAS 93

FOLCO GIUSTI. The fine structure of the style sac and intestine in *Mytilus galloprovincialis* Lam. 95

A. V. GROSSU. Comparative study of the species of *Lytopelte* Boettger of Roumania (Fam. Limacidae, Gastr. Pulmonata) and a description of a new species, *L. lotrensis* n.sp. 105

ANNETRUDI KRESS. A new record of *Trapania pallida* (Opisthobranchia, Gastropoda) with a description of its reproductive system and a comparison with *T. fusca* 111

MARGARET C. PILKINGTON. Young stages and metamorphosis in an atlantid heteropod occurring off south-eastern New Zealand 117

C. J. FEARE. The reproductive cycle of the dog whelk (*Nucella lapillus*) 125

M. J. WINTERBOURN. Population studies on the New Zealand freshwater gastropod, *Potamopyrgus antipodarum* (Gray) 139

BRIAN MORTON. The functional anatomy of the organs of feeding and digestion of *Teredo navalis* Linnaeus and *Lyrodus pedicellatus* (Quatrefages) 151

D. C. LLOYD. The origin of the odour of the garlic snail *Oxychilus alliarius* (Müller) (Pulmonata, Zonitidae) 169

D. C. LLOYD. Studies on some features peculiar to the skin of *Oxychilus* spp. (Pulmonata, Zonitidae) 175

F. C. VOHRA. Some studies on *Cerithidea cingulata* (Gmelin 1790) on a Singapore sandy shore 187

P. CALOW. Studies on the natural diet of *Lymnaea pereger obtusa* (Kobelt) and its possible ecological implications 203

N. B. EALES. On the migration of tectibranch molluscs from the Red Sea to the eastern Mediterranean 217

RAY GIBSON, T. E. THOMPSON and G. A. ROBILLIARD. Structure of the spawn of an Antarctic dorid nudibranch *Austrodoris macmurdensis* Odhner 221

Notes 227

Symposium Report 235

Unitas Malacologica Europaca 247

Accounts for the year ended 31 December 1969 249

Increase in Price
Notice to Subscribers

The price of *Proceedings* has remained unchanged since 1962. Unfortunately it is no longer possible to absorb the constant increases in production costs (approximately 15% in 1970 alone), and the subscription price for 1971 will be £5 ($17.00) per annum post free.

BLACKWELL SCIENTIFIC PUBLICATIONS
OXFORD AND EDINBURGH

Published 3 times a year at 25 shillings or 4 U.S. dollars
Annual subscription post free 60 shillings or 10 U.S. dollars
A volume consists of six parts

1970 PROCEEDINGS

NATIONAL SHELLFISHERIES ASSOCIATION

Volume 61

OFFICIAL PUBLICATION OF THE NATIONAL SHELLFISHERIES ASSOCIATION; AN ANNUAL JOURNAL DEVOTED TO SHELLFISHERY BIOLOGY

EDITOR

William N. Shaw
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Marine Extension — Shellfish
Oxford, Maryland 21654

Published for the National Shellfisheries Association, Inc. by
Economy Printing Co., Inc., Easton, Maryland

JUNE 1971

PROCEEDINGS
OF THE
NATIONAL
SHELLFISHERIES
ASSOCIATION

Volume 61 — June 1971

CONTENTS

List of Abstracts by Author of Technical Papers Presented at the 1970 NSA Convention v
Abstracts:
NSA Convention 1
NSA Pacific Coast Section 7
Fred W. Sieling
Economic Value of Research in Resources Management; An Exposition of Direct Economic Benefits to Management from Research 15
Ronald E. Westley
The Oyster Producing Potential of Puget Sound 20
Richard Keck, Don Maurer, James C. Kauer and William A. Sheppard
Chemical Stimulants Affecting Larval Settlement in the American Oyster 24
Kent S. Price, Jr. and Don Maurer
Holding and Spawning Delaware Bay Oysters (*Crassostrea virginica*) out of Season II. Temperature Requirements for Maturation of Gonads 29
Herbert Hidu and Harold H. Haskin
Setting of the American Oyster Related to Environmental Factors and Larval Behavior 35
Donald Moore and Lee Trent
Setting, Growth and Mortality of *Crassostrea virginica* in a Natural Marsh and a Marsh Altered by a Housing Development 51
Martin W. Newman
A Parasite and Disease Survey of Connecticut Oysters 59
Michael C. Mix and Albert K. Sparks
The Histopathological Effects of Various Doses of Ionizing Radiation on the Gonad of the Oyster, *Crassostrea gigas* 64
Jack I. Lowe, Paul D. Wilson, Alan J. Rick and Alfred J. Wilson, Jr.
Chronic Exposure of Oysters to DDT, Toxaphene and Parathion 71
Michael Castagna and William Duggan
Rearing the Bay Scallop, *Aequipecten irradians* 80
Roland L. Wigley and Roger B. Theroux
Association between Post-Juvenile Red Hake and Sea Scallops 86
John W. Ropes
Percentage of Solids and Length-Weight Relationship of the Ocean Quahog 88
A. J. McErlean and Jack Howard
Photographic Method for Surveying Clam Populations 91
Victor J. Cabelli and W. Paul Heffernan
Seasonal Factors Relevant to Coliform Levels in the Northern Quahaug 95
W. Paul Heffernan and Victor J. Cabelli
The Elimination of Bacteria by the Northern Quahaug: Variability in the Response of Individual Animals and the Development of Criteria 102
Association Affairs 109

PROCEEDINGS
OF THE
NATIONAL
SHELLFISHERIES
ASSOCIATION

LIST OF ABSTRACTS BY AUTHOR OF TECHNICAL PAPERS PRESENTED AT THE 1970 NSA CONVENTION

Donald M. Allen
Progress in Studies of the Calico Scallop 1
Neil Bourne
The Effects of Temperature, Salinity and Food on the Development of the Larvae of Butter Clams *(Saxidomus giganteus,* Deshayes) 1
Walter J. Canzonier
Measurement of the Oxygen Requirements of a Large Population of *Mercenaria mercenaria* 2
Nancy W. Davis and Robert E. Hillman
Effect of Artifical Shell Damage on Sex Determination in Oysters 2
Albert F. Eble
Histochemistry of Gonadal Regression and Subsequent Maturation in the Atlantic Surf Clam, *Spisula solidissims* 2
D. W. Ehresmann, C. E. Whalen and G. Claus
Optimal Pumping Rate Conditions for Oysters as Determined by a Fortran IV Program 3
Susan E. Ford
"MSX" — 10 Years in the Lower Delaware Bay 3
Frank L. Hamons and Ranford M. Sapp
Reconnaissance and Inventory of Shellfish in Chesapeake Bay — Present Techniques and Proposed Systems — A Management Problem 3
Dexter S. Haven and Reinaldo Morales-Alamo
Filtration of Particles from Suspension by the American Oyster, *Crassostrea virginica* 4
Harold H. Haskin and Walter R. Douglass
Experimental Approach to Oyster — "MSX" Interactions 4
Harold H. Haskin, Frederick Kruger and Stewart Tweed
River Flow and Salinity on Delaware Bay 4
Herbert Hidu
Field Oyster Setting — Component Systems 5
Robert E. Hillman
The Role of Mucosubstances in the Quahog 5
Arnold Martin
Cytology and Cytochemistry of Leucocytes of the Atlantic Surf Clam, *Spisula solidissima* 5
Allan A. Sollers
Factors Influencing Oyster Setting in the Chesapeake Bay Area 6
Victor Sprague and John Couch
An Annotated List of Protozoan Parasites, Hyperparasites and Symbionts of Decapod Crustacea 6

ABSTRACTS NSA PACIFIC COAST SECTION

Harold J. Barnett
Live-Crab Shipping 7
N. Bourne and D. W. Smith
The Effect of Temperature on the Larval Development of the Horse Clam, *Tresus capax,* Gould 7
W. P. Breese
Hot Water and Oysters 7

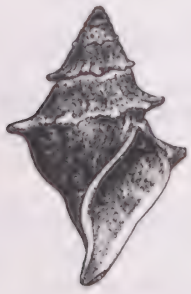
PROCEEDINGS NATIONAL SHELLFISHERIES ASSOCIATION

M. E. Fraidenburg
Observations on the Developing Fishery for Crayfish in Washington State 7
Jonathan Heller and Frieda B. Taub
The Production of Extracellular Products by the Marine Alga *Monochrysis lutheri* as a Nutrient Source for Bacteria 8
Jerry E. Jurkovich
The Shrimp-Fish Separator Trawl: Preliminary Observations on Its Introduction into the Oregon Fishery 8
John F. Karinen and David T. Hoopes
Occurrence of Tanner Crab *Chionoecetes* sp. in the Eastern Bering Sea with Characteristics Intermediate Between *C. bairdi* and *C. opilio* 8
Doyne W. Kessler and Charles R. Hitz
Subtidal Clam Explorations in Southeastern Alaska 9
Vance P. Lipovsky and Kenneth K. Chew
A Preliminary Report on Pacific Oyster *(Crassostrea gigas)* Mortality after Transfer from a Natural Bed into 10°C and 20°C Water in the Laboratory 9
Dennis Lund
Laboratory Studies on Setting of the Pacific Oyster 9
Robert Malouf
The Food Consumption and Growth of the Larvae of the Pacific Oyster, *Crassostrea gigas* 10
S. G. Martin and A. K. Sparks
Histopathologic Effects of Copper Sulfate on the Asiatic Freshwater Clam, *Corbicula fluminea* 10
Jack Neilsen
The Oregon Red Abalone Resource, Its Management Possibilities 10
Richard W. Nelson
Development of a Scallop Shucker 11
Terry Y. Nosho and Kenneth K. Chew
A Preliminary Survey into the Setting and Growth of the Manila Clam, *Venerupis japonica* (Deshayes) 11
Gilbert B. Pauley
Bacterial Clearance in the Marine Gastropod Mollusk *Aplysia californica* (Cooper) 11
Walter T. Pereyra
The Use of PVC Coatings in Dungeness Crab Pot Construction 12
F. Duane Phibbs
Temperature, Salinity and Clam Larvae 12
T. D. Schink and C. E. Woelke
Development of an *in situ* Marine Bioassay with Clams 13
A. J. Scholz and R. E. Westley
Second Year Survival and Growth of Pacific Oyster Seed from Five Sources Held at North Bay Oyster Reserve 13
A. J. Scholz and R. E. Westley
The Effect of Delayed Planting on Pacific Oyster Seed Survival and Growth 13
H. C. Tegelberg and D. Magoon
Handling Mortality on Softshell Dungeness Crabs 13
Wayne I. Tretsven
A Crab Meat Separator 14
Ronald E. Westley
Observations on Oyster and Shrimp Culture in Southern Japan 14

THE AMERICAN MALACOLOGICAL UNION, INC.

ANNUAL REPORTS for 1970

AMU, Thirty-Sixth Annual Meeting



CONTENTS

AMU Thirty-Sixth Annual Meeting 1

Papers read at AMU 36th Annual Meeting:

ACHATINA AND *RUMINA* IN THE UNITED STATES, STATUS OF (Abstract), Albert R. Mead 56

ACHATINA FULICA BOWDICH INFESTATION IN NORTH FLORIDA, Rita Sturgeon 52

ACTEOCINA CANALICULATA (SAY), POSSIBLE VARIABILITY IN LARVAL DEVELOPMENT BETWEEN POPULATIONS OF THE CEPHALASPID OPISTHOBRANCH, David R. Franz 68

AMBLEMA PLICATA IN LAKE ERIE, A STUDY OF THE GROWTH RATE AND LONGEVITY OF THE NAIAD, David H. Stansbery 78

AMPHIGYRA, MINIPLANORBIDS, AND MICROSCULPTURE IN PLANORBIDAE SYSTEMATICS, Harold J. Walter 47

BAY SCALLOPS, RAZOR CLAMS, AND MUSSELS, MINOR SPECIES, Robert W. Hanks 15

BIOLOGICAL SYSTEMATICS OF MARINE BIVALVES AND GASTROPODS, SYMPOSIUM INTRODUCTION AND CONCLUSIONS, Robert Robertson 62

CALICO SCALLOP, THE: FISHERY AND RESEARCH DEVELOPMENT, J. Harold Hudson 27

CEPHALOPOD RESOURCES AND FISHERIES IN THE NORTHWEST ATLANTIC, M. C. Mercer 30

CERITHIUM, REPRODUCTION AND DEVELOPMENT IN FLORIDA, Joseph R. Houbrick 74

COCHLIOLEPIS PARASITICA, A NON-PARASITIC MARINE GASTROPOD (Abstract), Donald R. Moore 80

COMMERCIAL MARINE MOLLUSKS OF THE UNITED STATES, SYMPOSIUM INTRODUCTION, Arthur S. Merrill 9

DITTO, SYMPOSIUM SUMMARY, Arthur S. Merrill 38

CONCH FISHERIES, Kenneth J. Boss 33

CORBICULA AND *DREISSENA* PARALLELS (Abstract), Ralph M. Sinclair 55

DISCUS, FERTILIZATION IN, Carl W. Gugler 43

DISCUS, THE RENOPERICARDIAL APERTURE IN, Kenneth R. Bazata 43

FLORIDA MALACOLOGY, A HISTORY OF (Abstract), William J. Clench 3
FLORIDA MARINE MOLLUSKS IN A NEW YORK CITY APARTMENT, MAINTAINING, Dorothy Raeihle 63
FRESHWATER SPONGES, UNIONID MUSSELS, AND SPHAERIID CLAMS, LABORATORY METHODS OF GROWING, Margaret L. Paige and Marc J. Imlay (Abstract) 44
GASTROPTERON, A FLORIDA (Abstract), G. W. Torrance 42
GREER ISLAND NATURE CENTER, FORT WORTH, TEXAS, THE LAND SNAILS OF, W. Lloyd Pratt 58
HARD CLAM AND SOFT CLAM OF THE WESTERN ATLANTIC COAST, THE, Carl M. Schuster, Jr. 13
HELICID LAND MOLLUSKS INTRODUCED INTO NORTH AMERICA (Abstract), Albert R. Mead 55
HYDROBIINAE, NAMES FOR THE SUBFAMILY, J. P. E. Morrison 7
INTRODUCED MOLLUSKS, SYMPOSIUM INTRODUCTION, Alan Solem 52
LITTORINA LITTOREA, NATIVE OR INTRODUCED? (Abstract), Arthur H. Clarke, Jr. 54
LITTORINIDS, THE REPRODUCTIVE BIOLOGY OF SOME SOUTH FLORIDA, Thomas V. Borkowski 61
LYMNAEA EMARGINATA SAY, A LOCAL CASE OF INTRA-POPULATIONAL VARIATION IN, Willard N. Harman 45
MARINE MOLLUSKS, THE WORLD CULTURE OF, Herbert Hidu 18
MARISA IN SOUTH FLORIDA, THE INTRODUCED FRESHWATER SNAIL (Abstract), Catherine Robins 3
MOLLUSKS FISHERIES, WEST COAST, Albert K. Sparks 16
MONTACUTA FLORIDANA DALL AND *ALIGENA ELEVATA* (STIMPSON) AS CLOSELY RELATED SPECIES (Abstract), Charles E. Jenner and Anne B. McCrary 42
NUDIBRANCH BIBLIOGRAPHY, A TYPE OF, Henry D. Russell 56
NUDIBRANCHS AND THEIR ALLIES–A 45 MINUTE COLOR MOVIE, Gale Sphon 61
OYSTER CULTURE FROM PAST TO FUTURE, A MONTAGE OF, Jay D. Andrews 11
PHESTILLA, COMPARATIVE BIOLOGY OF TWO CORAL-EATING NUDIBRANCHS OF THE GENUS, Larry G. Harris 67
POLLUTION AND COMMERCIAL MARINE MOLLUSKS, Arthur S. Merrill and Helen S. Lang 36
PREDATORS AND DISEASES OF COMMERCIAL MARINE MOLLUSCA OF THE UNITED STATES, Carl J. Sindermann 35
PROPEAMUSSIUM, THE GLASS SCALLOP, A LIVING RELIC OF THE PAST, Thomas R. Waller 5
SEA SCALLOP, THE, Arthur S. Merrill 24
SEXUALLY DIMORPHIC ARCHAEOGASTROPODS AND RADULAE, Robert Robertson 75
SHELLER, EVOLUTION OF A (Abstract), Morris K. Jacobson 8
SLUGS, INTRODUCED TERRESTRIAL, Lowell L. Getz 56
SPECIES OF MOLLUSKS, HOW MANY ARE THERE?, Kenneth J. Boss 41
SUBULINIDS AND VERONICELLIDS, INTRODUCED (Abstract), Dolores S. Dundee 55
SUNRAY VENUS CLAM FISHERY IN NORTHEAST FLORIDA, HISTORY AND CURRENT STATUS OF, Edwin A. Joyce, Jr. 29
SURF CLAMS AND OCEAN QUAHOGS, John W. Ropes 22
TEREBRIDAE, FEEDING MECHANISMS IN THE FAMILY, Bruce G. Miller 72
TEREBRIDAE, REMARKS ON SHELL MORPHOLOGY (Abstract), Twila Bratcher 78
THIARIDS IN THE UNITED STATES, INTRODUCTION AND SPREAD OF, Harold D. Murray 55
TOXOGLOSSATE RADULAE AND METHODS OF ENVENOMATION, EVOLUTION OF THE, Virginia O. Maes 69
TRIODOPSIS TRIDENTATA, VARIATIONS OF THE APERTURE TEETH OF, Harold S. Feinberg 60
UNDERSEA PARKS, FLORIDA, Martin F. Gomon 3
UROCYCLIDAE AND HALICARIONIDAE, ANATOMICAL STUDIES IN THE FAMILIES, Jean-Jacques Van Mol 57
WOOD BORING BIVALVE SYSTEMATICS, SOME ANATOMICAL AND LIFE HISTORY STUDIES OF, Ruth D. Turner and John L. Culliney 65

List of Attending Members and Guests 81
AMU Executive Council Meeting 86
AMU Annual Business Meeting 87
NEWS, NOTES, NOTICES 90
IN MEMORIAM 90
AMU Membership Lists 91
Authors' Index 112

Bulletin number 37, December 1, 1970. Issued annually by the American Malacological Union, Inc. Editorial Board: Morris K. Jacobson, Editor, Margaret C. Teskey, Secretary (Retiring), Marian S. Hubbard, Secretary. Office of Publication: 3957 Marlow Court, Seaford, New York 11783.

Mailed February 18, 1971

STERKIANA

NUMBER 37 *COLUMBUS, OHIO* *MARCH, 1970*

CONTENTS PAGE

AURÈLE LA ROCQUE -- UN MANUSCRIT INÉDIT DE L'ABBÉ PROVANCHER SUR LES MOLLUSQUES DU CANADA. 1

DON P. TANNER -- FIVE ADDITIONS TO SOUTHWESTERN PENNSYLVANIA NAIAD FAUNA. 27

JAMIE E. THOMERSON AND DONAL G. MYER -- *CORBICULA MANILENSIS:* RANGE EXTENSION UPSTREAM IN THE MISSISSIPPI RIVER. 29

NEW PUBLICATIONS. 30

REPRINTS OF RARE PAPERS ON MOLLUSCA: BRYANT WALKER (1918) SYNOPSIS AND CLASSIFICATION . . . . (CONTINUED FROM NO. 36) . . . . after page 30

EDITORIAL BOARD

HENRY VAN DER SCHALIE
UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

DAVID H. STANSBERY
OHIO STATE UNIVERSITY
COLUMBUS, OHIO

WILLIAM J. WAYNE
UNIVERSITY OF NEBRASKA
LINCOLN, NEBRASKA

AURÈLE LA ROCQUE
OHIO STATE UNIVERSITY
COLUMBUS, OHIO

EDITOR

AURÈLE LA ROCQUE
102 W. BEAUMONT ROAD
COLUMBUS, OHIO 43214

IN FUTURE, PLEASE ADDRESS ALL MAIL FOR STERKIANA TO THE ABOVE ADDRESS AND NOT TO THE ONE BELOW

Aurèle La Rocque
Department of Geology
Ohio State University
125 S. Oval Drive
Columbus 10, Ohio

STERKIANA

NUMBER 38 *COLUMBUS, OHIO* *JUNE 1970*

CONTENTS

WHOLE NUMBER:

PLEISTOCENE NON-MARINE MOLLUSCA OF THE GATINEAU VALLEY AND OTTAWA AREAS OF QUEBEC AND ONTARIO, CANADA

EDWIN DAVID BICKEL

. . . . . .

NO. 39 COLUMBUS, OHIO SEPTEMBER, 1970

CONTENTS PAGE

DOROTHY E. BEETLE -- A PHOTOGRAPHIC RECORD OF SNAIL ACTIVITY . . 1

THIRTY-SIXTH ANNUAL MEETING OF THE AMERICAN MALACOLOGICAL UNION, KEY WEST, FLORIDA, JULY 16-20 1970 . . . . . 8, 16, 38

BRANLEY A. BRANSON -- *JUGA, OXYTREMA* AND *MUDALIA*, AND A CORRECTION 9

LESLIE HUBRICHT -- THE LAND SNAILS OF NORTH CAROLINA 11

HENRY VAN DER SCHALIE -- MUSSELS IN THE HURON RIVER ABOVE ANN ARBOR IN 1969 17

FIELD JOURNAL OF HENRY A. PILSBRY PERTAINING TO NEW MEXICO AND TRANS-PECOS TEXAS 23

REPRINTS OF RARE PAPERS ON MOLLUSCA: BRYANT WALKER (1918) *SYNOPSIS AND CLASSIFICATION* (CONTINUED FROM NO. 37) *after page* 38

. . . . . .

NO. 40 COLUMBUS, OHIO DECEMBER, 1970

CONTENTS PAGE

JAMES A. DUKE -- PELECYPOD POLYCLAVE 1

INDEX TO STERKIANA 31-40 47

COMUNICACIONES
DE LA
Sociedad Malacológica
DEL
Uruguay

MONTEVIDEO URURUGUAY

Vol. II - N° 18 Abril de 1970

S U M A R I O

Pag.

FIGUEIRAS, Alfredo y SICARDI, Omar E. - Catálogo de los Moluscos Marinos del Uruguay (IV)..... 407

PENCHASZADEH, Pablo E. - Observaciones sobre una comunidad de Mytilus platensis d'Orb. localizada frente al Cabo San Antonio (B.A.)..... 425

BROGGI, Jorge - Sobre el Hallazgo de cinco nuevas especies para el Querandino uruguayo..... 427

DUARTE, Eliseo - Hacia el Volúmen III..... 432

- Notas de Secretaria 433

INDICE GENERAL DEL VOLUMEN II - Indice por autores..... I

- Indice alfabético de géneros y especies...

---o--o--00--o--o---

Secretario: ELISEO DUARTE

Casilla de Correo No. 1401 Montevideo - URUGUAY

Conchiglie

NOTIZIARIO MENSILE DEL « CONCHIGLIA CLUB »

UNIONE MALACOLOGICA ITALIANA - MILANO

ADERENTE ALLA

UNITAS MALACOLOGICA EUROPAEA

Anno VI - n. 1-2 gennaio-febbraio 1970

SOMMARIO

G. Barletta	Malacofauna del Mar Rosso: II° Eilat	pag.	1
G. Spada - L. Spada B. Sabelli	Note sulla famiglia *Spondylidae* . .	»	4
G. Barletta	Ritrovamenti malacologici nel Mediterraneo	»	13
G. Barsotti G. Frilli	Contributo alla conoscenza della malacofauna dei fondi sublitorali dell'alto Tirreno (Mare Toscano) . .	»	15

DIRETTORE RESPONSABILE rag. Italo Urio

COMITATO DI REDAZIONE O. Albanesi; D. A. Franchini; C. L. Garavelli; G. C. Melone; N. Melone; G. Spada.

DIREZIONE E REDAZIONE Milano, Via De Sanctis, 73 - Telefono 849.76.57

AUTORIZZAZIONE TRIBUNALE DI MILANO N. 98 DEL 28 MARZO 1967

Conchiglie

Anno VI - n. 3-4 marzo-aprile 1970

SOMMARIO

G. Barletta - Malacofauna del Mar Rosso: II° Eilat . . . . . pag. 17

G. Spada - L. Spada - B. Sabelli Note sulla famiglia *Spondylidae* . . » 22

G. Barletta - Ritrovamenti malacologici nel Mediterraneo . . . . . » 31

QUOTE DI ADESIONE

	Lire
SOCI SOSTENITORI	10.000
SOCI ORDINARI	4.000
SOCI GIOVANI	2.000

«Alla categoria "SOCI GIOVANI" appartengono tutti gli iscritti di età non superiore ad anni 15» (art. 4 dello Statuto).

Nella domanda di adesione i «Soci Giovani» devono indicare la loro data di nascita.

Le quote di adesione possono essere inviate con versamento sul c/c postale n. 3-42684 intestato al rag. Italo Urio, Via De Sanctis, 73 - Milano.

Tutta la corrispondenza deve sempre essere indirizzata

Impersonalmente a « Unione Malacologica Italiana »

VIA DE SANCTIS, 73 - MILANO

Anno VI - n. 3-4 marzo-aprile 1970

SUPPLEMENTO

Fernando Ghisotti e Giulio Cesare Melone

CATALOGO ILLUSTRATO DELLE CONCHIGLIE MARINE DEL MEDITERRANEO

Anno VI - 5-6 maggio-giugno 1970

SOMMARIO

FRANCHINI D. A. — Note bibliografiche . . . . . pag. 33

ALBANESI O. — Appunti su alcuni ritrovamenti malacologici nel mare di Posillipo (Golfo di Napoli) . . . . . » 35

BARLETTA G. — Ritrovamenti malacologici nel Mediterraneo . . . . . » 38

BARLETTA G. — Malacofauna del Mar Rosso: III° Tavole illustrative . . . . . » 43

BARSOTTI G. - FRILLI G. — Sulla presenza di *Neptunea sinistrorsa* (Deshayes) nel Mediterraneo . . » 52

Anno VI - n. 7-8 luglio-agosto 1970

SOMMARIO

GHISOTTI F. — La classe Aplacophora . . . . . pag. 61

GARAVELLI C.L. - MELONE N. — Ritrovamenti malacologici in Mediterraneo . . . . . » 67

MELONE N. - GARAVELLI C.L. — Sul ritrovamento di *Charonia variegata seguenzae* ARADAS e BENOIT, 1871 nel Golfo di Taranto . . . . . » 87

NOTE REDAZIONALI . . . . . » 101

Anno VI - n. 9-10 settembre-ottobre 1970

SOMMARIO

FRANCHINI D. A. — Note bibliografiche . . . . . pag. 105

ORIOLO G. — Conchiglie dello Jonio . . . . . » 107

ALBERGONI A. — FRANCHINI D. A.
FRANCHINI S. — SARTORE G. — Note sul ritrovamento e sull'habitat di numerosi esemplari di *Opalia* (*Dentiscala*) *crenata* (Linneo) e di altre *Scalidae* nel Mare di Almeria (Spagna) . . . . . » 119

PAVIA G. — DEMAGISTRIS L. — *Cypraecacea* del Pliocene medio-superiore di Valleandona (Asti) . . » 128

Subscription for year 1970: 8 Usa Dollars
Backnumbers of the year will be mailed to new subscribers.
The fiscal year is from Jannuary to December

ATTI

DELLA

UNIONE MALACOLOGICA ITALIANA

ADERENTE ALLA

UNITAS MALACOLOGICA EUROPAEA

ANNO I FASC. 1

n. 11 - 12 di

Conchiglie

novembre - dicembre 1970

INDICE
DEL PRESENTE FASCICOLO

GHISOTTI F. — Presentazione . . . . . pag. 1

BARSOTTI G. — FRILLI G. — *Panopea glycymeris* (Born, 1778) nel Porto di Livorno (*Mollusca, Lamellibranchiata*) . . . . . » 3

BARSOTTI G. — *Sphenia binghami* Turton e *Thracia* (*Izartia*) *distorta* (Montagu): due specie nuove per l'Alto Tirreno (*Mollusca, Lamellibranchiata*) . . . . . » 12

SORDI M. — Nuovo ritrovamento di *Glossodoris elegantula* (Philippi, 1844) (*Doris*) (*Gastropoda, Nudibranchiata*) . . . . . » 20

FRANCHINI D. A. — FRILLI G. — Il genere *Trophonopsis* B. D. D., 1882 nel Mar Mediterraneo . . » 30

MELONE N. — GARAVELLI C. L. — Sulla presunta « *Charonia mirabilis n. sp.* » nel Mediterraneo . . » 56

DIRETTORE RESPONSABILE Rag. Italo Urlo

COMITATO PROVVISORIO DI REDAZIONE G. Barsotti; D. A. Franchini; G. L. Garavelli; F. Ghisotti; G. C. Melone; N. Melone; G. Spada.

REDAZIONE Bari - Istituto di Mineralogia Università - Pal. Ateneo - Piazza Umberto, 1 - Tel. 21 66 40 - 21 66 60 - int. 214 - 353.

AUTORIZZAZIONE TRIBUNALE DI MILANO N. 98 DEL 28 MARZO 1967

PRESENTAZIONE

Il Notiziario dell'Unione Malacologica Italiana, passata la prima fase, chiamiamola così, di giovinezza, ha assunto una fisionomia più matura e più conscia del proprio compito. Compito che deve essere appunto quello di dare a ogni gruppo di soci quel tipo di informazioni che a quel gruppo interessa e che giustamente desidera ricevere.

Essendo però gli interessi dei soci quanto mai vari, era difficile riunire nello stesso numero del Notiziario le informazioni atte a soddisfare, anche in parte, le varie esigenze.

Per questa ragione fu deciso, a suo tempo, di iniziare il Catalogo delle Conchiglie Marine del Mediterraneo non come rubrica del Notiziario, bensì come supplemento allo stesso. Per questa ragione anche i lavori di maggior impegno non saranno più stampati nel Notiziario, ma troveranno ospitalità negli appositi « Atti », di cui questo fascicolo rappresenta il primo numero.

Il Notiziario vero e proprio, snellito dai lavori di più largo respiro, potrà così ospitare articoli divulgativi e di più immediata informazione ed essere anzi arricchito con nuove rubriche d'interesse pratico.

Gli Atti invece rappresenteranno il programma più ambizioso essendo destinati a colmare una lacuna nelle pubblicazioni scientifiche italiane. Non esiste infatti in Italia una pubblicazione che stampi lavori originali di malacologia, soprattutto marina. Lavori, spesso di grande importanza, vengono ospitati dalle riviste più disparate, sì da rendere veramente ardua la ricerca e l'aggiornamento bibliografico.

Con la pubblicazione di questi lavori su « Atti », lo studioso avrà a disposizione una fonte d'informazione vasta e di rapida consultazione.

Questo primo numero si presenta quindi al mondo scientifico con un programma di collaborazione fra specialisti italiani e stranieri. Se l'iniziativa avrà buon successo non è escluso che in futuro « Atti » vengano pubblicati in edizione bilingue, italiana e inglese. Ciò consentirà che i lavori di malacologia, soprattutto marina, effettuati in Italia, possano essere più facilmente conosciuti in campo internazionale.

Auspicando il più largo successo a questa iniziativa, invitiamo tutti gli specialisti a una fattiva collaborazione.

FERNANDO GHISOTTI

MALACOLOGICAL REVIEW

VOLUME 3 1970

CONTENTS

BAYNE, C. J. and KIME, J. B.

In vivo removal of bacteria from the hemolymph of the land snail *Helix pomatia* (Pulmonata: Stylommatophora) 103

BINDER, E. E.

Notice: Fourth European Malacological Congress 183

BURCH, J. B. and LINDSAY, G. K.

An immuno-cytological study of *Bulinus* s.s. (Basommatophora: Planorbidae) 1

Congrès de la Société Française de Malacologie 182

LO, C. T., BURCH, J. B. and SCHUTTE, C. H. J.

Infection of diploid *Bulinus* s.s. with *Schistosoma haematobium* 121

MORTON, B.

A note on the cytological structure and function of the digestive diverticula of *Macoma balthica* correlated with the rhythm of the tide 115

NATARAJAN, R.

Cytological studies of Indian mollusks: chromosomes of some opisthobranchs from Porto Novo, South India 19

Notice: Symposium on Indian mollusks and malacology 183

PATTERSON, C. M.

Morphological and cytological studies of the succineid genus *Quickia* from India 25

MALACOLOGICAL REVIEW

PENNEC, M. and LUCAS, A.

Comparative growth and morphology of some venerid larvae (Bivalvia, Veneridae) 175

PONDER, W. F.

The morphology of *Alcithoe arabica* (Gastropoda: Volutidae) 127

ROGINSKAYA, I. S.

Tenellia adspersa, a nudibranch new to the Azov Sea, with notes on its taxonomy and ecology 167

Brief Communications 175

Contents of Malacological periodicals, 1969 37

Author index and author's addresses for malacological periodicals, 1969 77

Publications 89, 185

Index to Scientific names 189

* * * * * *

MALACOLOGICAL REVIEW is published annually and may contain review articles on various aspects of malacology, experimental and descriptive papers on mollusks, information on current publications, malacological announcements of special interest, etc. Subscription price: US$ 5.00.

* * * * * *

MALACOLOGICAL REVIEW

P. O. Box 801
Whitmore Lake, Michigan 48189
U.S.A.

THE ECHO

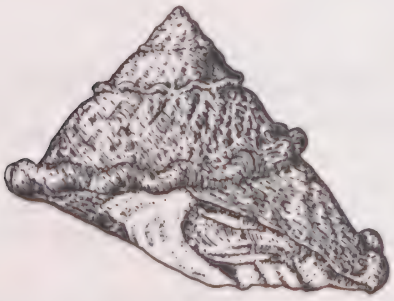
ABSTRACTS AND PROCEEDINGS

OF THE

THIRD ANNUAL MEETING

OF

THE WESTERN SOCIETY OF MALACOLOGISTS



June 24-27, 1970

Stanford, California

The Echo is the publication of the Western Society of Malacologists, Inc. (Incorporated 1968, San Diego, California), and is issued yearly. Distribution is free to members in good standing as of the year of issue. Copies are available to the public upon donation (tax-deductible) of $2.50 plus 50¢ mailing costs; members may obtain additional copies at the same price. Address requests to the Secretary of the Society.

Editorial Board

Barry Roth, Editor

Judith Terry Smith

A. Myra Keen, President
Western Society of Malacologists, 1969-1970

TABLE OF CONTENTS

	Page
PROGRAM	6
NOTICE OF THE FOURTH ANNUAL MEETING OF THE WESTERN SOCIETY OF MALACOLOGISTS	9
SUMMARY OF MINUTES, EXECUTIVE BOARD MEETINGS AND BUSINESS MEETING	9
TREASURER'S REPORT	13
ABSTRACTS OF PAPERS PRESENTED AT THE THIRD ANNUAL W. S. M. MEETING	
"Paleoclimatic History of the Northeastern Pacific Margin: A Paleontological Application of Modern Molluscan Zoogeographic Data," Warren O. Addicott	15
"Natural History and Occurrence of Opisthobranchs of Las Cruces, Baja California, Mexico, and Vicinity," Hans Bertsch, O.F.M.	16
"Terebridae of the Eastern Pacific," Twila Bratcher	17
"Amylotic Activity and Formation of the Crystalline Style in Corbiculidae and Veneridae," Beatrice L. Burch and Jerry Landye	18
"Dispersion of Cerithium stercusmuscarum on a Tidal Sandflat," Thomas A. Burch and Beatrice L. Burch	18
"A Review of the Introduced Opisthobranchs of the Eastern Pacific," James T. Carlton	19
"The Introduced Estuarine Invertebrates of the Eastern Pacific: Some Ecological Perspectives," James T. Carlton	19
"The Mills College Collection of the Letters and Possessions of Josiah Keep," James T. Carlton . .	20
"New Information on the Subfamilies of the Marginellidae," Eugene V. Coan	21
"The Intritacalx, a Previously Uninvestigated Surface Layer of Some Muricid Gastropod Shells," Anthony D'Attilio and George E. Radwin	21
"An Integrated Approach to Molluscan Systematics," George M. Davis	22
"Conservation of the Marine Environment," David Epel	22
"The Corbicula Story: Chapter Two," Ralph Olen Fox	23
"Zoogeography of Northwest Atlantic Nudibranch Mollusks," David R. Franz	23
"Recent Advances in the Systematics of Bivalve Shell Structures," George H. Hamilton	24

Abstracts (continued) Page

"The Ecology of Coral-Associated Nudibranchs of the Aeolid Genus Phestilla Bergh, 1874," L. G. Harris 25

"Reconciling Biological Nomenclature and the Phylogeny of Organisms," Harold W. Harry 25

"Techniques Useful in the Study of Invertebrate Animals with Shells," Fred Herzberg 26

"Life Story of the Tree Snail, Liguus fasciatus," Fran Hutchings 27

"Boring Shells Penetrating Volcanic Rocks," Koichiro Masuda 27

"Pigmentation of Nudibranchs," James W. McBeth . . . 28

"The Spread of the Giant African Snail to the Continental United States," Albert R. Mead 29

"Notes on Generic Names and Placement in the Muricacea and Buccinacea," George E. Radwin . . . 29

"Notes on the Anatomy of Two Species of Acteocina," Richard A. Roller 31

"The 'Systematics' of Curation," Barry Roth 32

"Notes on the Ecology and Distribution of Opisthobranchiate Mollusks of the San Carlos Bay Region, Gulf of California," Gary C. Williams and Terrence M. Gosliner 33

ADDRESS

"The Death of the Oceans," David Epel 34

ADDRESS

"Reconciling Biological Nomenclature and the Phylogeny of Organisms," Harold W. Harry 41

EXECUTIVE BOARD AND COMMITTEE MEMBERS 54

EXHIBITS AT THE THIRD ANNUAL MEETING 55

SPECIAL NOTE CONCERNING THE W.S.M. BY-LAWS 55

GROUP PHOTOGRAPH 56

MEMBERS AND GUESTS ATTENDING THE THIRD ANNUAL MEETING 57

MEMBERSHIP DIRECTORY 1969-1970 58

WESTERN SHELL CLUBS 69

LOST OPERCULUM CLUB LIST, Bertram Draper 71

La Conchiglia

ANNO II - N. 1 (11) GENNAIO 1970

SOMMARIO

Ai lettori 3

Le belle conchiglie da collezione 4, 5, 8, 9, 12
K. Nicoly
C. Tripodi

Invito al collezionismo 6,7

La ricerca delle conchiglie 10
C. Tripodi

Conchiglie di mare che si raccolgono in terra 11
S. Durante

Le meraviglie del mare 13, 14
E. Fresi

Posta del direttore 15

Mediterranea 15

Valutazione 15

ANNO II - N. 2 (12) FEBBRAIO 1970

SOMMARIO

Invito al collezionismo I monoplacophori 3
C. Tripodi

Le belle conchiglie da collezione 4, 5, 8, 9, 13
K. Nicoly
C. Tripodi
D. Franchini

Le meraviglie del mare 6,7
F. Cinelli

La ricerca delle conchiglie 10, 11
G. Zanardi

Notizie malacologiche 12

Posta del direttore 14

Filatelia conchiliologica 14

Offerte - scambi - richieste 15

Valutazione 15

ANNO II - N. 3 (13) MARZO 1970

SOMMARIO

Conchiglie di mare che si raccolgono in terra 3
S. Durante

Le belle conchiglie da collezione 4, 5, 8, 9
D. Franchini
K. Nicolay
C. Tripodi

Le meraviglie del mare 6, 7, 8
F. Cinelli

La ricerca delle conchiglie 10, 11, 12, 13
A. Mari
G. Zanardi

Varietà malacologiche 14

Filatelia 14

Valutazione 15

ANNO II - N. 4 (14) APRILE 1970

SOMMARIO

Invito al collezionismo 3, 4, 5
G. Barsotti

Le meraviglie del mare 6, 7
E. Fresi

Le belle conchiglie da collezione 8, 9, 13
K. Nicolay
C. Tripodi

Notizie malacologiche 10

La ricerca delle conchiglie 11, 12
G. Schirò

Museo malacologico in Messico 14
G. Melvin

Mostra di Conchiglie a Roma 14

Valutazione 15

La Conchiglia

RIVISTA MENSILE DELLE MERAVIGLIE DEL MARE

ANNO II - N. 5 (15) MAY 1970 INTERNATIONAL EDITION PRICE L. 500 - $ 0.80

La Conchiglia

Rivista mensile delle meraviglie del mare

Spediz. in abb. postale - Gruppo III - 70%
Autorizzaz. Trib. di Roma n. 12596 del 28-1-69
ANNO II - N. 5 (15) MAGGIO 1970

Redazione, amministrazione e pubblicità: Roma, Piazza S. Lorenzo in Lucina, 35 - c.p. 00186 - Tel. 640.570 - Condiz. d'abbonamento: per 12 numeri lire 2500, per 6 numeri lire 1350, da versare sul c/c postale n. 1/44900 o a mezzo vaglia all'amministrazione della Rivista. Estero lire 3.500 (Paesi del M.E.C. lire 3.000).

Subscription price for the U.S.A.: $ 6:
($ 8 for sending by airmail, if wished).
U.S.A. Agent: Dr. A. Gordon Melvin
863 Watertown St.
W. Newton, Mass. 02165
Tip. Tibergraf - Roma - Tel. 58.10.222

DIRETTORE:
KETY NICOLAY
DIRETTORE RESPONSABILE
FRANCESCO BENEDETTI
REDAZIONE SCIENTIFICA: GIANFRANCO BARSOTTI, GIANCARLO CARRADA, FRANCESCO CINELLI, DARIO FRANCHINI, EUGENIO FRESI, ALBERTO MALATESTA.
CONSULENZA: FRANCESCO SETTEPASSI.

COLLABORATORI: PAOLO ANGIOY, GUIDO DONATI, SILVIO DURANTE, CARLO GARAVELLI, RANIERO MALTINI, ANGELO MARI, FRANCA PAPARO, PIETRO SOLAINI, CARLO TRIPODI, GADDO ZANARDI.
FOTO: MALTINI e SOLAINI, MARIANI, TRIPODI.
TRADUZIONE INGLESE: ANNA APRILE

SOMMARIO

La pulizia delle conchiglie — 3
C. Tripodi

Gloria maris — 4

Le belle conchiglie da collezione — 5, 8, 9, 12, 13
C. Tripodi
K. Nicolay

La ricerca delle conchiglie — 6, 7, 10, 11
G. Zanardi
Angelo Mari

Filatelia conchiliologica — 14

Notizie malacologiche — 14

Valutazione — 13

« La Conchiglia » which is issued monthly beginning march 1969, is dedicated above all to collectors, amateurs and to whoever enjoys the wonders of the sea: but we know that it will also interest experts. This is the first issue in English, which we send to you as a samplecopy. The following issues will be both in English and Italian.

From the first number up until now, about 400 shells have been illustrated, the major part in color (the numeration which appears in the index does not include the shells illustrated per family). Mediterranean shells (most of which are also Atlantic) are systematically treated, and the same will be done for the shells of other malacological provinces: the magazine is completed by other columns of malacological interest (fossils shells, marine biology, conchiological philatelia u.s.o.), with numerous illustrations in color and black and white.

The subscription price for the international edition in $ 8,50, $ 6 for the italian, per year or for 12 numbers. Back numbers are presently available only in Italian, but we are preparing the translation of these in leaflets.

Our general Agent for the U.S.A. is dr. A. Gordon Melvin 863 Waertown Street, West Newton, Mass. 02165, to whom U.S. residents can foreward their subscription money. Otherwise the subscription price can be send directly to us, Piazza S. Lorenzo in Lucina, 35 00186 Roma, through Bank, or Bank cheks, or international Postal order.

La Conchiglia

Rivista mensile delle meraviglie del mare

Spediz. in abb. postale - Gruppo III - 70% Autorizzaz. Trib. di Roma n. 12596 *del* 28-1-69
ANNO II - N. 6 (16) GIUGNO 1970

Redazione, amministrazione e pubblicità: Roma, Via Tomacelli 186 (IV piano) - c.p. 00186 - Tel. 640.570 — *Abbonamento - Subscription*: Ed. ital.: Italia (anno o 12 num.) L. 2.500; sem. o 6 num. L. 1.350, da versare sul C/C postale N. I/44900 o a mezzo vaglia all'amministrazione della Rivista. Paesi del MEC L. 3000. Altri Paesi L. 3.500. - Ed. inglese: Italia L.4500; Estero L. 5000 (anno o 12 num.) Num. arretrati: ed. it. L. 300 - ed. ingl. L. 500. U.S.A. Agent: Dr. A. Gordon Melvin - 863 Watertown St. - W. Newton, Mass. 02165 - Italian Edit. $6 a year (or 12 numbers) - English Edit. $8.50 a year (or 12 numbers) - Back numbers $0.50 (It. ed.), $1 (Eng. ed.) Airmailing: Europe $1.30 - America $2 - Australia and South Africa $3.
Tip. Tibergraf - Roma - Telefono 58.10.222

DIRETTORE-EDITORE:
KETY NICOLAY

DIRETTORE RESPONSABILE
FRANCESCO BENEDETTI

REDAZIONE SCIENTIFICA: GIANFRANCO BARSOTTI, GIANCARLO CARRADA, FRANCESCO CINELLI, DARIO FRANCHINI, EUGENIO FRESI, ALBERTO MALATESTA.
CONSULENZA: FRANCESCO SETTEPASSI.
COLLABORATORI: PAOLO ANGIOY, GUIDO DONATI, SILVIO DURANTE, CARLO GARAVELLI, RANIERO MALTINI, ANGELO MARI, FRANCA PAPARO, PIETRO SOLAINI, CARLO TRIPODI, GADDO ZANARDI.
FOTO: MALTINI, SOLAINI E MARIANI.
TRADUZIONE INGLESE: ANNA APRILE

SOMMARIO

Le belle conchiglie da collezione 3, 4, 5, 9, 13
D. Franchini, C. Tripodi, K. Angioy

Ritrovamenti malacologici 6

Le meraviglie del mare 7, 8
E. Fresi

Invito al collezionismo 10
A. Mari

La ricerca delle conchiglie 11, 12
G. Zanardi

Notizie malacologiche 13

Anno II - N. 7-8 (17-18) LUGLIO-AG. 1970

SOMMARIO

Le belle conchiglie da collezione 3, 4, 5, 12, 13, 14, 17
K. Angioy - C. Tripodi

Invito al collezionismo 6
G. Barsotti

La ricerca delle conchiglie 7
D. Franchini

Superfamiglia Trochacea 8
G. Zanardi

Conchiglie di mare che si raccolgono in terra 11
S. Durante

II - La pulizia delle conchiglie 15

Filatelia Conchigliologica 18

Notizie Malacologiche 19

Parchi nazionali marini 19, 20

Per Raniero Maltini 21
E. Fresi

Posta del Direttore 22

Valutazione 22

Anno II - N. 9 (19) SETTEMBRE 1970

SOMMARIO

Nascita della nomenclatura binomia ecc. 3-6
A Malatesta

Le belle conchiglie da collezione 4-5-6-7
K. Angioy - C. Tripodi

Invito al collezionismo
La ricerca delle conchiglie 6-7
P. Franchini

Libri ricevuti 10

Notizie macologiche 10

La ricerca delle conchiglie 11-12
G. Zanardi

Le meraviglie del mare 13-14

Mediterranea 15

La Conchiglia

Rivista mensile delle meraviglie del mare

Spediz. in abb. postale - Gruppo III - 70%
Autorizzaz. Trib. di Roma n. 12596 del 28-1-69
Anno II - N. 10 (20) OTTOBRE 1970

Redazione, amministrazione e pubblicità: Roma, Via Tomacelli 146 (IV piano) - c.p. 00186 - Tel. 640.570 — *Abbonamento - Subscription*: Ed. ital.: Italia (anno o 12 num.) L. 2.500; sem. o 6 num. L. 1.350, da versare sul C/C postale N. I/44900 o a mezzo vaglia all'amministrazione della Rivista. Paesi del MEC L. 3000. Altri Paesi L. 3.500. - Ed. inglese: Italia L.4500; Estero L. 5000 (anno o 12 num.) Num. arretrati: ed. it. L. 300 - ed. ingl. L. 500. U.S.A. Agent: Dr. A. Gordon Melvin - 863 Watertown St. - W. Newton, Mass. 02165 - Australia and Austral. Agent - Mr. Olaf Christensen - 405, Bay Street - Morth Brighton 3186 - Victoria, Australia.
Italian Edit. $6 a year (or 12 numbers) - English Edit. $8.50 a year (or 12 numbers) - Back numbers $0.50 (It. ed.), $1 (Eng. ed.) Airmailing: Europe $1.30 - America $2 - Australia and South Africa $3.
Tip. Tibergraf - Roma - Telefono 58.10.222

DIRETTORE-EDITORE:
KETY NICOLAY

DIRETTORE RESPONSABILE
FRANCESCO BENEDETTI

REDAZIONE SCIENTIFICA: GIANFRANCO BARSOTTI, DARIO FRANCHINI, EUGENIO FRESI, ALBERTO MALATESTA.

CONSULENZA: FRANCESCO SETTEPASSI.

COLLABORATORI: PAOLO ANGIOY, SILVIO DURANTE, CARLO GARAVELLI, ANGELO MARI, FRANCA PAPARO, PIETRO SOLAINI, CARLO TRIPODI, GADDO ZANARDI.

FOTO: SOLAINI, BONFIGLIO E MORELLI.

TRADUZIONE INGLESE: ANNA APRILE

SOMMARIO

Invito al collezionismo — 3
D. Franchini

La ricerca delle conchiglie - Superfamilia Trochidae — 6, 7, 8
G. Zanardi

Le belle conchiglie da collezione — 4, 5, 9, 12
K. Angioy
A. Mari

Notizie malacologiche — 6

La pulizia delle conchiglie — 10, 11
C. Tripodi

La conchiglia nell'arte e nell'arredamento — 13

Filatelia — 14

Valutazione — 14

La Conchiglia

Rivista mensile delle meraviglie del mare

Spediz. in abb. postale - Gruppo III - 70%
Autorizzaz. Trib. di Roma n. 12596 del 28-1-69
Anno II - N. 11-12 (21-22) DICEMBRE 1970

Redazione, amministrazione e pubblicità: Roma, Via Tomacelli 146 (IV piano) - c.p. 00186 - Tel. 640.570 — *Abbonamento - Subscription*: Ed. ital.: Italia (anno o 12 num.) L. 2.500; sem. o 6 num. L. 1.350, da versare sul C/C postale N. I/44900 o a mezzo vaglia all'amministrazione della Rivista. Paesi del MEC L. 3000. Altri Paesi L. 3.500. - Ed. inglese: Italia L.4500; Estero L. 5000 (anno o 12 num.) Num. arretrati: ed. it. L. 300 - ed. ingl. L. 500. U.S.A. Agent: Dr. A. Gordon Melvin - 863 Watertown St. - W. Newton, Mass. 02165 - Australia and Austral. Agent - Mr. Olaf Christensen - 405, Bay Street - Morth Brighton 3186 - Victoria, Australia.
Italian Edit. $6 a year (or 12 numbers) - English Edit. $8.50 a year (or 12 numbers) - Back numbers $0.50 (It. ed.), $1 (Eng. ed.) Airmailing: Europe $1.30 - America $2 - Australia and South Africa $3.
Tip. Tibergraf - Roma - Telefono 58.10.222

DIRETTORE-EDITORE:
KETY NICOLAY

DIRETTORE RESPONSABILE
FRANCESCO BENEDETTI

REDAZIONE SCIENTIFICA: GIANFRANCO BARSOTTI, DARIO FRANCHINI, EUGENIO FRESI, ALBERTO MALATESTA.

CONSULENZA: FRANCESCO SETTEPASSI.

COLLABORATORI: PAOLO ANGIOY, SILVIO DURANTE, CARLO GARAVELLI, ANGELO MARI, FRANCA PAPARO, PIETRO SOLAINI, CARLO TRIPODI, GADDO ZANARDI.

FOTO: SOLAINI, BONFIGLIO E MORELLI.

TRADUZIONE INGLESE: ANNA APRILE

SOMMARIO

Avvisi — 3

Le belle conchiglie da collezione — 4, 5, 6, 7, 8, 9, 16, 17
P. Franchini
C. Tripodi
K. Angioy

Libri ricevuti — 10

La ricerca delle conchiglie mediterranee — 11, 12, 13
G. Schirò

Conchiologia: Regina delle scienze naturali — 14, 15
Tucher Abbott

Notizie malacologiche - Posta del Direttore - Valutazione — 18

Le meraviglie del mare — 19, 20, 21
E. Fresi
V. Fornaseri

Supplemento mensile catalogo - I conidi — 22, 23
V. Nostriand

ARGAMON

ארגמון

כתב - עת של האגודה המלקולוגית בישראל

כרך |

מס |

1970

JOURNAL OF

THE ISRAEL MALACOLOGICAL SOCIETY

VOL. | **1970**

The Israel Malacological Society
P.O.Box 9216 Haifa, Israel.

Board: Z. Bar-Chairman, I. Yaron - Secretary, P.S. Tsuriel-Treasurer, D.C. Insall, D. Peled, O.Drezdner.
Annual membership fees: $ 5.- payable to the Israel Malacological Society, c/o Dr. P.S. Tsuriel, 35 Weizmann St., Naharya, Israel.

Editorial Board: I. Yaron, D.C. Insall
Cover Drawing: M. Hiller
Address: P.O.Box 9216, Haifa, Israel

ARGAMON

Journal of the Israel Malacological Society

Vol. 1 No. 1 July 1970.

Contents

Editorial..... 1
H.K. Mienis: Notes on the distribution and morphology of the Volema pyrum - complex 2
I. Yaron: New finds: Scala pumicea (Brocchi, 1814) found at Shikmona..... 8
Z. Bar: Opercula, epiphragms and clausilia..... 11
P.S. Tsuriel: Encounter with the sea hare - Aplysia... 18
D.A. Visker: How to strengthen fossil shells..... 23
Prof. Fritz Haas, 1886 - 1969..... 25
Recent publications concerning our region..... 28
Malacological crossword (In Hebrew)..... 31
Editorial post (In Hebrew)..... 33
The Israel Malacological Society (In Hebrew)..... 35
Editorial (In Hebrew)..... 36

"Argamon" is the Hebrew name for the Murex snail, found in our Mediterranean coasts. As related in our ancient literature, our forefathers extracted the Royal Purple dye from this snail. We have selected this name for our journal to stress the connection of the activities of our Society and the subject matter of its journal with our country, its fauna, and its past.

"Argamon" is the journal of a society, whose members range from professional malacologists and students of zoology, through veteran and advanced collectors, to amateurs at the very initial level. We intend to publish material, which may be of interest and of use to all our readers. Accordingly, without sacrifice of scientific precision, we will not strictly adhere to conventional forms of publication in established professional journals.

"Argamon" is the journal of a malacological society. We shall not limit our interests to shells only, but will also publish information on the marine, sweet-water and land molluscs, that create the remarkable shells we admire, and dedicate space to their biology, anatomy, physiology, ecology etc.

"Argamon" is the journal of the Israel Malacological Society. Our primary interests lie in the malacology of our country and our region. To our readers abroad we shall try to bring papers on original research carried out in this country. Items of local interest will be published in Hebrew.

We wish to stress that all papers are published on the responsibility of their authors. Our readers are invited to comment on and discuss materials published in "Argamon", and to bring to our attention noticed errors and misprints, and suggestions for improvement of the journal. We expect a lively participation of our readers in forthcoming issues of "Argamon".

ARGAMON

Journal of the Israel Malacological Society
Editorial Board : I. Yaron, D.C. Insall, H.K. Mienis.
Cover Drawing : M. Hiller.
Address : P.O.Box 9216, Haifa, Israel

Vol. 1 No. 2 December 1970

Contents

H.K. Mienis: A checklist of Terebridae from the northern part of the Red Sea, with notes on Terebra areolata, T. consobrina and T. subulata 37

R. Rosin: On Aeolidoidea, Coelenterata and nematocysts.... 43

H.K. Mienis: Some notes on freshwater mollusca from the marshes of Kurdani, Galilee..... 51

Recent publications concerning our region..... 55

Book review..... 58

Editorial post..... 59

A. Aboulafia: Preparation of radulae for microscopic observation and permanent mounting (in Hebrew)..... 68

The Israel Malacological Society (in Hebrew)..... 72

The kind support of Rotary Club, Naharya in the publication of this issue is gratefully acknowledged.

The Israel Malacological Society
P.O.Box 9216 Haifa, Israel.

Annual membership fees : $ 5.- payable to the Israel Malacological Society, c/o Dr. P.S. Tsuriel, 35 Weizmann Str., Naharya, Israel.

Malacological Review, 1971, 4: 256-264

AUTHOR INDEX FOR MALACOLOGICAL PERIODICALS, 1970*

	page**
ABBOTT, R.T., Delaware Museum of Natural History, Greenville, Delaware 19807, U.S.A.	252
ABOULAFIA, A., Seminar "Oranim", Kyriat Tiv'on, Israel	255
ADDICOTT, Warren O., U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025, U.S.A.	247
ALBANESI, O. [no address given]	241
ALBERGONI, A. [no address given]	241
ALLEN, D. M., U.S. Dept. Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Trop. Atlantic Biological Lab., Miami, Florida, U.S.A.	232
ANDREWS, J. D., Virginia Institute of Marine Science, Gloucester Point, Virginia, U.S.A.	235
ANGIOY, K. [no address given]	251,252
APLEY, M. L., Department of Biology, Brooklyn College, Brooklyn, New York 11210, U.S.A.	227
BAR, Z., Kibbutz Beth Ha'emek, Dqar na Ma'aleh Haglil, Israel	254
BARLETTA, G. [no address given]	239,240,241
BARNETT, H. J., U.S. Dept. of Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Seattle Tech. Lab., Seattle, Washington, U.S.A.	232
BARSOTTI, G., Istituto di Zoologia dell'Università, Via Mattioli 4, 53100 Siena, Italy	239,241,242,249,251
BAYNE, C. J., Museum of Zoology, University of Michigan, Ann Arbor, Michigan 48104, U.S.A.	244
BAZATA, K. R., Oldfather Hall 434, Lincoln, Nebraska 68508, U.S.A.	234
BEETLE, D. E., Peninsula Nature Museum, Newport News, Virginia 23601, U.S.A.	237
BERTSCH, Hans, Franciscan School of Theology, Holy Names College, 1712 Euclid Avenue, Berkeley, California 94709, U.S.A.	247
BICKEL, E. D., Department of Geology, Ohio State University, Columbus, Ohio 43210, U.S.A.	237
BINDER, E., Museum of Natural History, CH-1211 Geneva 6, Switzerland	228,244
BOETERS, H. D., Rumfordstr. 42, D-8 Munich 5, West Germany	228
BORKOWSKI, T. V., U.S. Army Preventive Medicine Activity (PI-WOZL-AA), APO, San Francisco, California 96331, U.S.A.	235
BOSS, K. J., Museum of Comparative Zoology, Harvard University Cambridge, Massachusetts 02138, U.S.A.	234,235
BOURNE, N., Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C., Canada	232
BRANSON, Branley A., Eastern Kentucky University, Richmond, Kentucky 40475, U.S.A.	237
BRATCHER, Twila, 8121 Mullholland Terrace, Hollywood, California 90046, U.S.A.	235,247
BREESE, W. P., Department of Fisheries and Wildlife, Oregon State Marine Science Center, Newport, Oregon, U.S.A.	232

*For 1970 periodicals listed in this issue of *Malacological Review* (p 225-255). For other 1970 malacological periodicals, see *Malacological Review*, 4(1): 71-99 (author index, p 100-106).

**Page numbers, this issue of *Malacological Review*.

	page
BROGGI, Jorge, Juan Ramón Gómez 3221, Montevideo, Uruguay	238
BURCH, B. L., 236 Kuukoa Place, Kailua, Oahu, Hawaii 96734, U.S.A.	247
BURCH, J. B., Museum and Department of Zoology, University of Michigan, Ann Arbor, Michigan 48104, U.S.A.	244
BURCH, T. A., 236 Kuuhoa Place, Kailua, Oahu, Hawaii 96734, U.S.A.	247
CABELLI, V. J., Environmental Protection Agency, Northeastern Water Hygiene Laboratory, Narragansett, Rhode Island, U.S.A.	231
CALOW, P., Department of Zoology, University of Leeds, U.K.	229
CANZONIER, W. J., Oyster Research Laboratory, N. J. Agricultural Exper. Station, Rutgers University, New Brunswick, New Jersey, U.S.A.	232
CARLTON, James T., Department of Invertebrate Zoology, California Academy of Sciences, San Francisco, California 94118, U.S.A.	247
CASTAGNA, M., Virginia Institute of Marine Science, Wachapreague, Virginia, U.S.A.	231
CHEW, K. K., College of Fisheries, University of Washington, Seattle, Washington, U.S.A.	233
CINELLI, F. [no address given]	249
CLARKE, A. H. Jr., Department of Mollusks, National Museum of Canada, Ottawa, Ontario, Canada	235
CLAUS, G., Offshore/Sea Development Corporation, New York, N.Y., U.S.A.	232
CLENCH, W. J., 26 Rowena Street, Dorchester, Massachusetts 02124, U.S.A.	235
COAN, Eugene V., Department of Geology, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118, U.S.A.	247
COUCH, J., U.S. Dept. Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Biological Laboratory, Oxford, Maryland, U.S.A.	232
CULLINEY, J. L., Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.	235
D'ATTILIO, A., San Diego Natural History Museum, San Diego, California 92001, U.S.A.	247
DAVIS, G. M., Academy of Natural Sciences of Philadelphia, 19th and the Parkway, Philadelphia, Pennsylvania, U.S.A.	247
DAVIS, N. W., William F. Clapp Laboratories, Battelle Memorial Institute, Duxbury, Massachusetts, U.S.A.	232
DEMAGISTRIS, L. [no address given]	241
DOUGLASS, W. R., Oyster Research Laboratory, N.J. Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey, U.S.A.	232
DRAPER, B. C., 8511 Bleriot Ave., Los Angeles, California 90045, U.S.A.	248
DUARTE, E., Casilla de Correo No. 1401, Montevideo, Uruguay	238
DUGGAN, W., Virginia Institute of Marine Science, Wachapreague, Virginia, U.S.A.	231
DUKE, James A., 2269 Mc Coy, Columbus, Ohio 43220, U.S.A.	237
DUNDEE, D. S., Department of Biology, Louisiana State University in New Orleans, New Orleans, Louisiana 70150, U.S.A.	235
DURANTE, S. [no address given]	249, 251
EALES, N. B., University of Reading, Reading, England, U.K.	229

page

EBLE, A. F., Department of Biology, Trenton State College, Trenton, New Jersey, U.S.A. 232
EHRESMANN, D. W., Offshore/Sea Development Corporation, New York, N.Y., U.S.A. 232
EPEL, D., Hopkins Marine Station, Stanford University, Pacific Grove, California, U.S.A. 247,248
FEARE, C. J., Culterty Field Station, Newburgh, Aberdeenshire, AB4 OAA, U.K. 229
FEINBERG, H. S., Department of Living Invertebrates, American Museum of Natural History, New York, N.Y. 10024, U.S.A. 235
FIGUEIRAS, A., Juan Ramón Gómez 3248, Montevideo, Uruguay 238
FISCHER, P.-H., 18/55 Prince Albert St., Mosman, N.S.W. Australia 2088 228
FORD, S. E., Oyster Research Laboratory, N. J. Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey, U.S.A. 232
FORNASERI, V. [no address given] 252
FOX, R. O., Department of Invertebrate Zoology, California Academy of Sciences, San Francisco, California 94118, U.S.A. 247
FRAIDENBURG, M. E., Washington State Department of Fisheries, Brinnon, Washington, U.S.A. 233
FRANCHINI, D. A., 37, Via Cremona, I-46100 Mantova, Italy 241,242,249,251,252
FRANCHINI, P. [no address given] 251,252
FRANZ, David R., Systematic and Environmental Biology, Biological Sciences, University of Connecticut, Storrs, Connecticut 06268, U.S.A. 251,247
FRESI, E. [no address given] 249,251,252
FRILLI, G., [no address given] 239,241,242
GARAVELLI, C. L., Istituto di Minaralogia, Palazzo Ateno, I-70100 Bari, Italy 241,242
GETZ, L. L., Department of Zoology, University of Illinois, Urbana, Illinois, U.S.A. 235
GHISOTTI, F., Via Giotto 9, I-20145, Milano, Italy 240,241,242,243
GIBSON, R., Zoology Department, University of Liverpool, Liverpool, U.K. 229
GIUSTI, Foko, Instituto di Zoologie dell'Università di Siena, via Mattioli 4, Siena, Italy 229
GOMON, M. F., Institute of Marine Sciences, Miami, Florida, U.S.A. 235
GOSLINER, Terrence M., 859 Butterfield Road, San Anselmo, California 94960, U.S.A. 248
GREENE, R. W., Department of Biology, University of Notre Dame, Notre Dame, Indiana 46556, U.S.A. 227
GROSSU, A. V., Facultatea de St. Naturale, Splaiul Independentei 93, Bucuresti, Roumania 229
GUCKERT, R.H., Department of Biological Sciences, Florida State University, Tallahassee, Florida 32306, U.S.A. 227
GUGLER, C. W., Department of Zoology, University of Nebraska, Lincoln, Nebraska 68508, U.S.A. 234
HAMILTON, G. H., Smithsonian Institution, Washington, D.C. 20560, U.S.A. 247
HAMONS, F. L., Fish & Wildlife Administration, Annapolis, Maryland, U.S.A. 232
HANKS, R. W., U.S. Dept. Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Biological Laboratory, Oxford, Maryland, U.S.A. 234
HARMAN, W. N., Science NYSU College, Oneonta, New York 13820, U.S.A. 235
HARRIS, L. G., Department of Zoology, University of New Hampshire, Durham, New Hampshire 03824, U.S.A. 235,248

	page
HARRY, H.W., Biology Department, Texas A and M University, College Station, Texas 77843, U.S.A.	248
HASKIN, H.H., Oyster Research Laboratory, New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey, U.S.A.	231,232
HAVEN, D.S., Virginia Institute of Marine Science, Gloucester Point, Virginia, U.S.A.	232
HEARD, W.H., Department of Biological Sciences, Florida State University, Tallahassee, Florida 32306, U.S.A.	227
HEFFERNAN, W.P., Environmental Protection Agency, Northeastern Water Hygiene Laboratory, Narragansett, Rhode Island, U.S.A.	231
HELLER, J., College of Fisheries, University of Washington, Seattle Washington, U.S.A.	233
HERZBERG, F., UCLA Center for Health Sciences, Los Angeles, California 90024, U.S.A.	248
HIDU, H., Ira C. Darling Center, University of Maine, Walpole, Maine 04573, U.S.A.	231,232,235
HILLMAN, R.E., Wm. F. Clapp Laboratories, Inc. of Battelle Memorial Institute, Duxbury, Massachusetts, U.S.A.	232
HITZ, C.R., U.S. Dept. Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Exploratory Fishing and Gear Research Base, Seattle, Washington, U.S.A.	233
HOOPES, D.T., U.S. Dept. of Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Biological Laboratory, Auke Bay, Alaska, U.S.A.	233
HOUBRICK, J.R., 220 S. 56th Ave., Hollywood, Florida 33023, U.S.A.	234
HOWARD, J., Educational Science Programs, New York, N.Y., U.S.A.	231
HUBRICHT, L., 4026 35th St., Meridian, Mississippi 39301, U.S.A.	237
HUDSON, J.H., U.S. Dept. Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Trop. Atlantic Biol. Lab., Miami, Florida, U.S.A.	234
HUTCHINGS, F.L., 3910 Battersea Road, Coconut Grove, Florida 33133, U.S.A.	248
IMLAY, M.J., National Water Quality Laboratory, 6201 Congdon Blvd., Duluth, Minnesota 55804, U.S.A.	235
JACOBSON, M.K., 455 Beach 139 Street, Rockaway Beach, New York 11693, U.S.A.	235
JENNER, C.E., Department of Zoology, University of North Carolina, Chapel Hill, North Carolina, U.S.A.	235
JOYCE, E.A., Jr., Florida Department of Natural Resources Marine Research Laboratory, St. Petersburg, Florida, U.S.A.	235
JURBERG, P., Instituto Oswaldo Cruz, Caixa Postal 926, Guanabara, Brazil	227
JURKOVICH, J.E., U.S. Dept. of Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Explor. Fish & Gear Research Base, Seattle, Washington, U.S.A.	233
KARINEN, J.F., Biological Laboratory, Auke Bay, Alaska, U.S.A.	233
KAUER, J.C., E.I., DuPond DeNemours and Co., Wilmington, Delaware, U.S.A.	231
KECK, R., College of Marine Studies, University of Delaware, Lewes, Delaware, U.S.A.	231
KESSLER, D.W., U.S. Dept. of Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Explor. Fish. & Gear Research Base, Kodiak, Alaska, U.S.A.	233

	page
KIME, J.B., Department of Zoology, University of Washington, Seattle Washington 98105, U.S.A.	244
KLAPPENBACH, A., Museo Nacional de Historia Natural, Montevideo, Uruguay	228
KRESS, A., Anatomisches Institut der TH Aachen, Aachen, W. Germany	229
KRUEGER, F.E., Oyster Research Laboratory, New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey, U.S.A.	232
LANDYE, J., Department of Zoology, Arizona State University, Tempe, Arizona 85281, U.S.A.	247
LANG, H.S., U.S. Dept. Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Trop. Atlantic Biol. Lab., Miami, Florida, U.S.A.	235
LA ROCQUE, A., 102 W. Beaumont Road, Columbus, Ohio 43214, U.S.A.	236
LINDSAY, G.K., Museum of Zoology, Ann Arbor, Michigan 48104, U.S.A.	244
LIPOVSKY, V.P., College of Fisheries, University of Washington, Seattle, Washington, U.S.A.	233
LLABADOR, Francis, Mas "Les Deux-Frères", Chemin des Mendrous, 34 Castelnau-le-lez, France	228
LLOYD, D.C., Department of Zoology and Comparative Anatomy, University College, Cardiff, U.K.	227, 229
LO, C.T., Institute of Pathobiology, Haile Sellassie I University, Addis Ababa, Ethiopia	244
LOWE, J.I., Environmental Protection Agency, Pesticides Office, Gulf Breeze Laboratory, Gulf Breeze, Florida, U.S.A.	231
LUCAS, A., Laboratoire de Zoologie, Faculté des Sciences, 29-N Brest, France	228
LUND, D., Oregon State University, Marine Science Center, Newport, Oregon, U.S.A.	233
MAES, V.O., Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania 19103, U.S.A.	235
MAGOON, D., Washington Department of Fisheries, Aberdeen, Washington, U.S.A.	233
MALATESTA, A., Servizio Geologico d'Italia, Largo Santa Susanna 13, Roma, Italy	251
MALOUF, R., Shellfish Laboratory, University of Delaware, Lewes, Delaware, U.S.A.	233
MARI, A. [no address given]	249, 250, 251, 252
MARTIN, A., Department of Biology, Trenton State College, Trenton, New Jersey, U.S.A.	232
MARTIN, S.G., College of Fisheries, University of Washington, Seattle, Washington, U.S.A.	233
MASUDA, Kôichirô, Department of Geology, Miyagi University, Sendai, Japan	248
MAURER, D., College of Marine Studies, University of Delaware, Lewes, Delaware, U.S.A.	231
McBETH, J.W., The Scripps Institution of Oceanography, La Jolla, California, U.S.A.	248
McCRARY, A.B., University of South Carolina at Wilmington, Wrightsville Marine Bio-Medical Laboratory, Wilmington, North Carolina, U.S.A.	235
McCRAW, B.M., Department of Pathology, Ontario Veterinary College, University of Guelph, Guelph, Ontario, Canada	227
McERLEAN, A.J., Natural Resources Institute, University of Maryland Prince Frederick, Maryland, U.S.A.	231

	page
McSWEENY, E.S., Institute of Marine Sciences, University of Miami, Miami, Florida, U.S.A.	227
MEAD, A.R., Department of Biological Sciences, University of Arizona, Tucson, Arizona, U.S.A.	234, 235, 248
MELONE, G.C., Via L. Armaroli 48, 62100 Macerata, Italy	240
MELONE, N. [no address given]	241, 242
MELVIN, G., 863 Watertown St., W. Newton, Massachusetts 02165, U.S.A.	249
MERCER, M.C., Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland, Canada	234
MERRILL, A.S., Bureau of Commercial Fisheries, Biological Laboratory, Oxford, Maryland 21654, U.S.A.	234, 235
MIENIS, H.K., Netzer Sereni, Doar Be'er Ya'akov, Israel	254, 255
MILLER, B.G., Smithsonian Tropical Research Institute, Balboa, Canal Zone, Panama	235
MIX, M.C., Department of General Science, Oregon State University, Corvallis, Oregon, U.S.A.	231
MOORE, D., U.S. Dept. of Commerce, Natn. Oceanic and Atmosph. Admin., Natn. Mar. Fish. Serv. Biological Laboratory, Galveston, Texas, U.S.A.	231
MOORE, D.R., Institute of Marine Sciences, University of Miami, Virginia Key, Miami, Florida 33149, U.S.A.	234
MORALES-ALAMO, R., Virginia Institute of Marine Science, Gloucester Point, Virginia, U.S.A.	232
MORRISON, J.P.E., Division of Mollusks, U.S. National Museum, Washington, D.C. 20560, U.S.A.	235
MORTON, B., Department of Zoology, The University of Hong Kong, Hong Kong.	229, 244
MURRAY, H.D., Biology Department, Trinity University, San Antonio, Texas 78212, U.S.A.	235
MYER, D.G., Faculty of Biological Sciences, Southern Illinois University Edwardsville, Illinois 62025, U.S.A.	236
NATARAJAN, R., Marine Biological Station, Porto Novo, Tamil Nadu State, India	244
NEILSEN, J., Oregon Fish Commission, Newport, Oregon, U.S.A.	233
NELSON, R.W., U.S. Dept. of Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Seattle Technology Laboratory, Seattle, Washington, U.S.A.	233
NEWMAN, M.W., U.S. Dept. of Commerce, Natn. Oceanic and Atmosph. Admin., Natn. Mar. Fish. Serv., Biological Laboratory, Oxford, Maryland, U.S.A.	231
NICOLAY, K., via Tomacelli, 146-IV P., 00186, Roma, Italy	249, 250
NOSHO, T.Y., College of Fisheries, University of Washington, Seattle, Washington, U.S.A.	233
NOSTRIAND, V. [no address given]	252
ORIOLO, G. [no address given]	241
PAIGE, M.L., U.S. Dept. of Interior, Federal Water Quality Administration National Water Quality Laboratory, Duluth, Minnesota, U.S.A.	235
PATTERSON, C.M., Museum of Zoology, University of Michigan, Ann Arbor, Michigan 48104, U.S.A.	228, 244
PAULEY, G.B., Department of Developmental and Cell Biology, University of California, Irvine, California, U.S.A.	233
PAVIA, G. [no address given]	241

	page
PENCHASZADEH, P. E., Instituto de Biología Marina, Casilla de Correo 175, Mar del Plata, Argentina	238
PENNEC, M. Le, Laboratoire de Zoologie, Faculte des Sciences, 29-N Brest, France	245
PEREYRA, W. T., U. S. Dept. of Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Explor. Fish & Gear Research Base, Seattle, Washington, U. S. A.	233
PILKINGTON, M. C., Portobello Marine Biological Station, New Zealand	229
PHIBBS, F. D., Marine Science Center Fish Commission of Oregon, Newport, Oregon, U. S. A.	233
PONDER, W. F., Australian Museum, Sydney, Australia	245
PRATT, W. L. Jr., Department of Natural Science, Fort Worth Museum of Science and History, 1501 Montgomery St., Ft. Worth, Texas 76107, U. S. A.	235
PRICE, K. S., College of Marine Studies, Lewes, Delaware, U. S. A.	231
RADWIN, George E., San Diego Natural History Museum, San Diego, California 92112, U. S. A.	247, 248
RAEIHLE, D., 5346 82nd St., Elmhurst, New York 11373, U. S. A.	235
RICK, A. J. [deceased]	231
ROBERTSON, R., Department of Mollusks, Academy of Natural Science of Philadelphia, Philadelphia, Pennsylvania 19103, U. S. A.	234, 235
ROBILLIARD, G. A., Zoology Department, University of Washington, Seattle, Washington 98105, U. S. A.	229
ROBINS, C., Institute of Marine Sciences, Miami, Florida, U. S. A.	235
ROGINSKAYA, I. S., Institute of Oceanology, U. S. S. R. Academy of Sciences, Moscow, U. S. S. R.	245
ROLLER, R. A., 1127 Seaward Street, San Luis Obispo, California 93401, U. S. A.	248
ROPES, J. W., Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Biological Laboratory, Oxford, Maryland 21654, U. S. A.	231, 235
ROSIN, R., 16 W 82 St., New York, N. Y., U. S. A.	255
ROTH, Barry, Department of Geology, California Academy of Sciences, San Francisco, California 94118, U. S. A.	248
RUSSELL, H. D., Springdale Avenue, Dover, Massachusetts, 02030, U. S. A.	235
SABELLI, B. [no address given]	239, 240
SAPP, R. M., Westinghouse Ocean Research & Engineering Center, Annapolis, Maryland, U. S. A.	232
SARTORE, G. [no address given]	241
SCHINK, T. D., Washington State Department of Fisheries, Brinnon, Washington, U. S. A.	233
SCHIRÒ, G. [no address given]	249, 252
SCHOLZ, A. J., Washington Department of Fisheries, Brinnon, Washington, U. S. A.	233
SCHUSTER, C. M. Jr., U. S. Dept. H. E. W., Publ. Hlth. Serv. Environ. Hlth. Serv., Environ. Control Admin. Cincinnati Labs., Bureau of Water Hygiene, Cincinnati, Ohio, U. S. A.	235
SCHUTTE, C. H. J., Bilharzia Research Unit, South African Council for Scientific and Industrial Research, Nelspruit, Transvaal, Republic of South Africa	244
SHEPPARD, W. A., E. I. DuPont DeNemours and Co., Wilmington, Delaware, U. S. A.	231
SICARDI, Omar E., Coquimbo 2371, Montevideo, Uruguay.	238

	page
SIELING, F.W., Fish and Wildlife Administration, State of Maryland, Annapolis, Maryland, U.S.A.	231
SINCLAIR, R.M., FWPCA Training, Cincinnati, Ohio, U.S.A.	234
SINDERMANN, C.J., U.S. Dept. Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Trop. Atlantic Biol. Lab., Miami, Florida, U.S.A.	235
SMITH, D.W., Fisheries Research Board of Canada, Nanaimo, British Columbia, Canada	232
SOLEM, A., Department of Zoology, Field Museum of Natural History, Chicago, Illinois 60605, U.S.A.	235
SOLLERS, A.A., Piankatank Oyster Company, Inc., Williamsburg, Virginia, U.S.A.	232
SORDI, M. Acquario Communale, 57100 Livorno, Italy	242
SPADA, G., Via San Felice 25, 40122 Bologna, Italy	239, 240
SPADA, L., [no address given]	239, 240
SPARKS, A.K., College of Fisheries, University of Washington, Seattle, Washington, U.S.A.	231, 233, 235
SPHON, G.G. Jr., Los Angeles County Museum, Los Angeles, California 90007, U.S.A.	235
SPRAGUE, V., Chesapeake Biological Laboratory, Solomons, Maryland, U.S.A.	232
STANSBERY, D.H., Natural History Museum, Columbus, Ohio 43210, U.S.A.	234
STURGEON, R.K., 6273 Miller Road, South Miami, Florida 33155, U.S.A.	234
TANNER, D.P., The Society for Pennsylvania Archaeology, 3223 Arapahoe Road, Pittsburgh, Pennsylvania 15241, U.S.A.	236
TAUB, F.B., College of Fisheries, University of Washington, Seattle, Washington, U.S.A.	233
TEGELBERG, H.C., Washington Department of Fisheries, Aberdeen, Washington, U.S.A.	233
THEROUX, R.B., U.S. Dept. of Commerce, Natn. Oceanic and Atmosph. Admin., Natn. Mar. Fish. Serv., Biological Laboratory, Woods Hole, Massachusetts, U.S.A.	231
THOMERSON, J.E., Faculty of Biological Sciences, Southern Illinois University, Edwardsville, Illinois 62025, U.S.A.	236
THOMPSON, T.E., Zoology Department, University of Bristol, Bristol, U.K.	229
TORRANCE, G.W., 5561 9th Avenue N, St. Petersburg, Florida 33710, U.S.A.	235
TRENT, L., U.S. Dept. of Commerce, Natn. Oceanic and Atmosph. Admin., Natn. Mar. Fish. Serv. Biological Laboratory, Galveston, Texas, U.S.A.	231
TRETSVEN, W.I., U.S. Dept. of Commerce, Natn. Oceanic & Atmosph. Admin., Natn. Mar. Fish. Serv., Seattle Tech. Laboratory, Seattle, Washington, U.S.A.	233
TRIPODI, C. [no address given]	249, 250, 251, 252
TSURIEL, P.S., 35 Weizmann St., Naharya, Israel	254
TURNER, R.D., Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.	235
TWEED, S., Oyster Research Laboratory, N.J. Agricultural Experiment Station, Rutgers University, New Brunswick, New Jersey, U.S.A.	232
VAN DER SCHALIE, H., Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, U.S.A.	237
VAN MOL, J.-J., Université Libre de Bruxelles, Brussels, Belgium	235

	page
VISKER, D.A., The Hague, The Netherlands	254
VOHRA, F.C., Unit of Ecology, School of Biological Sciences, University of Malaya, Kuala, Lumpur, Malaysia	229
WALLER, T.R., Department of Paleobiology, U.S. National Museum, Washington, D.C. 20560, U.S.A.	235
WALTER, H.J., Dayton, Ohio, U.S.A.	234
WATABE, N., Electron Microscope Laboratory, Le Conte Building, University of South Carolina, Columbia, South Carolina 29208, U.S.A.	227
WESTLEY, R.E., State of Washington Department of Fisheries, Shellfish Laboratory, Brinnon, Washington, U.S.A.	231, 233
WHALEN, C.E., Offshore/Sea Development Corporation, New York, N.Y., U.S.A.	232
WIGLEY, R.L., U.S. Dept. of Commerce, Natn. Oceanic and Atmosph. Admin., Natn. Mar. Fish. Serv., Biological Laboratory, Woods Hole, Massachusetts, U.S.A.	231
WILBUR, K.M., Department of Zoology, Duke University, Durham, North Carolina 27706, U.S.A.	227
WILLIAMS, Gary C., 267 Oak Manor Drive, Fairfax, California 94930, U.S.A.	248
WILSON, Alfred J. Jr., Environmental Protection Agency, Pesticides Office, Gulf Breeze Laboratory, Gulf Breeze, Florida, U.S.A.	231
WILSON, P.D., Environmental Protection Agency, Pesticides Office, Gulf Breeze Laboratory, Gulf Breeze, Florida, U.S.A.	231
WINTERBOURN, M., Department of Zoology, University of Canterbury, Christchurch, New Zealand	227, 229
WOELKE, C.E., Washington State Department of Fisheries, Brinnon, Washington, U.S.A.	233
YARON, I., Rehov Hagalil 51, Haifa, Israel	254
ZANARDI, G., via C. Poma 2, Roma, Italy	249, 250, 251, 252
ZISCHKE, J.A., Biology Department, St. Olaf College, Northfield, Minnesota 55057, U.S.A.	227

Malacological Review, 1971, 4: 265-272

CONTENTS OF MALACOLOGICAL PERIODICALS, 1971

The current contents of malacological periodicals for 1971, as shown by their tables of contents, are herewith reproduced (with permission) as a service to our readers. Those 1971 journals that do not appear in this current issue of *MALACOLOGICAL REVIEW* will be included in the next number (Vol. 5, No. 1).

Tables of contents of publications included in this issue of *MALACOLOGICAL REVIEW* are:

Journal	Country	Page
Malacologia	International	265
Archiv für Molluskenkunde	Germany (FRG)	266
The Journal of Conchology	U. K. and Ireland	267
The Nautilus	U. S. A.	268
Proceedings of the Malacological Society of London	U. K.	269
The Veliger	U. S. A.	270-271
Sterkiana	U. S. A.	272

Vol. 11, No. 1 **MALACOLOGIA** September, 1971

CONTENTS

C. M. YONGE

On functional morphology and adaptive radiation in the bivalve superfamily Saxicavacea (*Hiatella* (=*Saxicava*), *Saxicavella*, *Panomya*, *Panope*, *Cyrtodaria*) 1

P. CHANLEY and J. D. ANDREWS

Aids for identification of bivalve larvae of Virginia 45

D. BOLTOVSKOY

Pteropodos Thecosomados del Atlantico sudoccidental 121

D. S. BROWN, G. OBERHOLZER and J. A. VAN EEDEN

The *Bulinus natalensis/tropicus* complex (Basommatophora: Planorbidae) in south-eastern Africa:
I. Shell, mantle, copulatory organ and chromosome number 141

D. S. BROWN, G. OBERHOLZER and J. A. VAN EEDEN

The *Bulinus natalensis/tropicus* complex (Basommatophora: Planorbidae) in south-eastern Africa:
II. Some biological observations, taxonomy and general discussion 171

A. S. ELWELL and M. J. ULMER

Notes on the biology of *Anguispira alternata* (Stylommatophora: Endodontidae) 199

H. M. LAWS

The chromosomes of some Australasian Paryphantidae 217

Archiv für Molluskenkunde

der Senckenbergischen Naturforschenden Gesellschaft
Organ der Deutschen Malakozoologischen Gesellschaft

Begründet von Prof. Dr. W. Kobelt
Weitergeführt von Dr. W. Wenz und Dr. F. Haas
Herausgegeben von Dr. A. Zilch

Band 101 Nummer 1/4

Inhalt.

Zilch, A.: Franz Alfred Schilder (1896-1870). 1
Schilder, M.: Die Typen der von F. A. Schilder nach 1958 benannten Cypraeacea. 19
Forcart, L.: Revision der Daudebardiinae von Vorderasien (excl. Kaukasusgebiet). 21
Nordsieck, H.: Zur Anatomie und Systematik der Clausilien, IX. Dinarische Clausiliidae, III: Das Genus *Herilla*. (Tafel 1-5). 39
— — — : Zur Nomenklatur der *Cristataria*-Arten Palästinas. 89
Temcharoen, P.: New aquatic molluscs from Laos. (Plate 6-7). 91
Brandt, R. A. M. & Temcharoen, P.: The molluscan fauna of the Mekong at the foci of Schistosomiasis in South Laos and Cambodia. 111
Truc, G.: *Discus (Discus) vireti*, nouvelle espèce du Miocène inférieur de l'Allier (France) (Gastropoda, Euthyneura). 141
Schlickum, W. R. & Strauch, F.: Die neue Helicidengattung *Frechenia* aus dem westeuropäischen Pliozän. (Tafel 8-9). 145
Schlickum, W. R.: Zur Systematik fossiler Hydrobiiden. (Tafel 10). 159
Boeters, H. D.: *Iglica pezzolii* n. sp. und ein neues Merkmal zur Unterscheidung zwischen *Bythiospeum* und *Paladilhia* (Prosobranchia, Hydrobiidae). .. 169
— — — : *Pseudamnicola* Paulucci, 1878 und *Mercuria* n. gen. (Prosobranchia, Hydrobiidae). 175
Altena, C. O. van Regteren: Mitteilungen über Nacktschnecken, 18. Neue Fundorte von *Arion lusitanicus* Mabille. 183
Nordsieck, F.: Kontinentale und abyssische Meeresmollusken des Jonischen Meeres. 187
Kadolsky, D.: Nomenklatorische Bemerkungen. 191
Hudec, V. & Lezhawa, G.: *Abchasohela* n. nom. für *Hela* Hudec & Lezhawa, 1970. 194
Zilch, A.: Die Typen und Typoide des Natur-Museums Senckenberg, 47: Mollusca-Euthyneura von A. Döring aus Argentinien. (Tafel 11-13). 195

Frankfurt am Main 1971

| Arch. Moll. | 101 | (1/4) | 1—214 | Frankfurt a. M., 30. 7. 1971 |

THE JOURNAL OF CONCHOLOGY

Vol. 26 JULY 1971 No. 6

CONTENTS

PAGE

NORA F. MCMILLAN—Large *Cardium edule* L. and *Mytilus edulis* L. . 353

S. PETER DANCE—The Cook Voyages and Conchology . . 354

G. E. BEEDHAM—The extrapallial cavity in *Anodonta cygnea* (L.) inhabited by an insect larva 380

G. A. S. BARNACLE—Note on a Streptaxid from Seychelles *Imperturbatia levieuxi* (Nevill & Nevill) 386

M. R. BLOCK—Epiphragms: some observations . . . 388

A. J. CAIN—Undescribed polymorphisms in two British snails. . 410

B. VERDCOURT—*Physa* in East Africa 417

Obituaries: Herbert Leader Hawkins, F.R.S., 1887–1968; Douglas Keely Kevan, 1895–1968; Douglas Panton Blair, 1883–1968 . . 418

Reviews 422

Proceedings: Members Elected 425

Index to Volume 26 427

PLATE 16

Price in the U.S.A. $5.50 **Price £2**

Vol. 27 No. 4 May, 1971

Contents

PAGE

H. E. J. BIGGS—Mollusca of the Iranian Plateau III 211

H. E. J. BIGGS—On a proposed new genus of Cerithid mollusca from the Dahlak Islands, Red Sea 221

Review 224

P. J. C. RUSSELL—A reappraisal of the geographical distributions of the cockles, *Cardium edule L.* and *C. glaucum* Bruguière 225

SHELAGH M. SMITH—*Rissoa violacea* Desmarest, *Rissoa lilacina* Récluz, *Rissoa rufilabrum* Alder and *Rissoa porifera* Lovén and their distribution in British and Irish waters. 235

D. M. DUVAL—A note on the acceptability of various weeds as food for *Agriolimax reticulatus* (Müller) 249

Review 252

STELLA M. TURK—WILLIAM PENNINGTON COCKS (1791–1878), a west country naturalist 253

Review 256

HILDEGARD ZEISSLER—On *Fagotia acicularis* (Férussac) from the quaternary deposits in the valley of Helme and Unstrut 257

NORA F. MCMILLAN—Three lamellibranchs apparently new to Britain 266

Review 167

F. R. WOODWARD—Descriptions of two new species of fossil freshwater mussels (*Unionidae*) from Greenland 269

NORA F. MCMILLAN—*Tellina serrata* Brocchi a British species 272

A. J. CAIN—Obituary. Captain Cyril Diver (1892–1969) 273

Officers and Council for 1970–1971 277

Proceedings of the Conchological Society of Great Britain and Ireland 278

Vol. 84 JANUARY, 1971 No. 3

THE NAUTILUS

THE PILSBRY QUARTERLY
DEVOTED TO THE INTERESTS OF CONCHOLOGISTS

EDITORS AND PUBLISHERS
R. Tucker Abbott, du Pont Chair of Malacology
Delaware Museum of Natural History, Greenville, Del. 19807
Horace Burrington Baker, 11 Chelten Road, Havertown, Pa.
(Emeritus Professor of Zoology, University of Pennsylvania)
Charles B. Wurtz, *Biology Department*
La Salle College, Philadelphia, Pa. 19141

CONTENTS

Cadulus (Gadila) perpusillus (Sowerby, 1832) an earlier name for *C. (G.) panamensis*. By William K. Emerson 77
New typhid species from the South China Sea. By T. Habe and S. Kosuge 82
New *Ancistrolepis* from the Bering Sea (Buccinidae). By T. Habe and K. Ito 84
Environmental control of form in land snails—a case of unusual precision. By Stephen J. Gould 86
New Hydrobiidae from Ozark Caves. By Leslie Hubricht ... 93
The ecological significance of *Thyasira bisecta* Conrad. By Saburo Kanno 96
On some Helicina from the Dominican Republic. By M. K. Jacobson and W. J. Clench 101
A new species of *Ashmunella* from the Davis Mountains in West Texas. By E. P. Cheatum 107
Athearnia, new name for a genus of pleurocerid snails. By J. P. E. Morrison 110
News ..... 111 Publications received ... 112

Vol. 84 APRIL, 1971 No. 4

CONTENTS

A deep water *Omalogyra* in the Western Atlantic. By Donald R. Moore 113
A scanning electron microscope study of the marginal teeth of *Nerita peloronta* Linnaeus. By Ronald Frank Thomas 118
A new *Ashmunella* (Polygyridae) from Doña Ana County, New Mexico. By A. L. Metcalf and P. A. Hurley 120
On a sinistral chondropomine from Jamaica. By M. K. Jacobson and K. J. Boss 127
Strombus gigas Linnaeus from the Bowden Formation, Jamaica. By Peter Jung 129
Anatomy and geographic distribution of the succineid gastropod, *Succinea vaginacontorta* Lee. By D. S. Franzen 131
Notes and News ..... 143 Publications received 146

Mrs. Horace B. Baker, Business Manager
11 Chelten Road, Havertown, Pennsylvania 19083

PROCEEDINGS OF THE

Malacological Society

OF LONDON

VOLUME 39 · PART 4 · APRIL 1971

CONTENTS

PRESIDENTIAL ADDRESS. R. D. PURCHON. Digestion in filter feeding bivalves—a new concept 253

D. S. BROWN. Ecology of Gastropoda in a South African mangrove swamp 263

MARGARET C. PILKINGTON. The veliger stage of *Hydrobia ulvae* (Pennant) 281

BRIAN MORTON. Studies on the biology of *Dreissena polymorpha* Pall. V. Some aspects of filter-feeding and the effect of micro-organisms upon the rate of filtration 289

S. G. PAL. The fine structure of the digestive tubules of *Mya arenaria* L. 303

R. A. D. CAMERON and M. A. PALLES-CLARK. *Arianta arbustorum* (L.) on chalk downs in southern England 311

YORAM YOM-TOV. Body temperature and light reflectance in two desert snails 319

NOTES. R. STOREY. Some observations on the feeding habits of *Lymnaea peregra* (Müller) 327

VOLUME 39 · PART 5 · AUGUST 1971

CONTENTS

GEORGE R. HAMPSON. A species pair of the genus *Nucula* (Bivalvia) from the eastern coast of the United States 333

W. JUDD. The structure and habits of *Divariscintilla maoria* Powell (Bivalvia: Galeommatidae) 343

EVELINE DU B. R. MARCUS. On some euthyneuran gastropods from the Indian and Pacific Oceans 355

CHARLES W. THAYER. Fish-like crypsis in swimming Monomyaria 371

Note 377

Review 379

Annual Report of the Council, 1970–1971 381

THE VELIGER

A Quarterly published by
CALIFORNIA MALACOZOOLOGICAL SOCIETY, INC.
Berkeley, California

VOLUME 13 January 1, 1971 NUMBER 3

CONTENTS

Mouse Ascites Fluid as a Source of Antibody Against Molluscan Antigens. (4 Plates; 4 Text figures; 21 Tables)
GEORGE M. DAVIS & SETSUKO SUZUKI 207

Some Paleogene Mud Pectens of the Genus *Propeamussium* from Alaska and California. (1 Plate)
WARREN O. ADDICOTT 226

Niche Differences in the Intertidal Limpets *Acmaea scabra* and *Acmaea digitalis* (Gastropoda) in Central California (10 Text figures)
STONER B. HAVEN 231

Marine Fouling and Boring Organisms at 100 Feet Depth in Open Water of Monterey Bay. (3 Text figures; 2 Tables)
EUGENE C. HADERLIE 249

Sixteen New Species and One New Genus of Japanese Ovulidae (Gastropoda). (2 Plates; 8 Text figures)
MASAO AZUMA & CRAWFORD N. CATE 261

The Influence of Water Temperature on the Morphology of *Leptopecten latiauratus* (CONRAD, 1837) (1 Plate)
GEORGE R. CLARK, II 269

On the Function of the Digestive Gland in *Nassarius* (Gastropoda : Prosobranchia) (1 Plate)
N. MCLEAN 273

Orientation of the Bivalve *Anadara trapezia* (DESHAYES) Relative to Water Currents (1 Text figure)
A. K. O'GOWER & PATRICIA I. NICOL 275

[Continued on Inside Front Cover]

Distributed free to Members of the California Malacozoological Society, Inc.
Subscriptions (by Volume only) payable in advance to Calif. Malacozool. Soc., Inc.
Volume 13: $18.- Domestic; $19.- in the Americas; $19.50 in all other Foreign Countries
Single copies this issue $14.-. Postage extra.
Send subscription orders to Mrs. JEAN M. CATE, 12719 San Vicente Boulevard, Los Angeles, California 90049. *Address all other correspondence to* Dr. R. STOHLER, *Editor*, Department of Zoology, University of California, Berkeley, California 94720
Second Class Postage Paid at Berkeley, California

CONTENTS — *Continued*

The Ecology of *Macoma inconspicua* (BRODERIP & SOWERBY, 1829) in Central San Francisco Bay. Part II. Stratification of the *Macoma* Community within the Substrate (6 Text figures)
MARILYN T. VASSALLO 279

Cellulase from the Crop of *Aplysia vaccaria* WINKLER, 1955 (4 Text figures)
ROBERT L. KONINGSOR, Jr. & DON HUNSAKER II 285

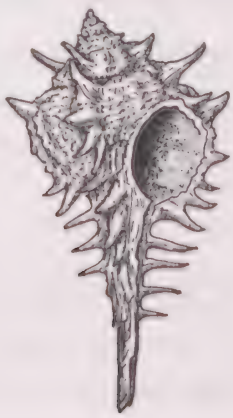
On the Identity of *Conus cedonulli* LINNAEUS, 1767. (1 Plate)
V. ROGER DUNN 290

Cypraea cervus and *Cypraea zebra* in Florida – One Species or Two? (1 Plate; 1 Map)
M. ELLEN CROVO 292

NOTES & NEWS 296

Two New Supraspecific Taxa in the Gastropoda. A. MYRA KEEN
Range of *Gastropteron pacificum* BERGH, 1893. EVELINE MARCUS
The Occurrence of *Ancula pacifica* MACFARLAND in San Francisco Bay. DAVID W. BEHRENS
Egg Capsule and Early Veliger of *Charonia tritonis* (LINNAEUS). (1 Text figure) CARL J. BERG, Jr.
The Occurrence of *Urosalpinx cinerea* (SAY) in Newport Bay, California. VERNON L. HUMAN

BOOKS, PERIODICALS & PAMPHLETS 301



Note: The various taxa above species are indicated by the use of different type styles as shown by the following examples, and by increasing indentation.

ORDER, Suborder, DIVISION, Subdivision, SECTION,
SUPERFAMILY, FAMILY, Subfamily, *Genus, (Subgenus)*
New Taxa

STERKIANA

NO. 41 COLUMBUS, OHIO MARCH, 1971

CONTENTS PAGE

AURÈLE LA ROCQUE -- UN MANUSCRIT INÉDIT DE L'ABBÉ PROVANCHER SUR LES MOLLUSQUES DU CANADA SUITE 1

BRANLEY A. BRANSON - LOCALITY RECORDS FOR OKLAHOMA MOLLUSCA . . 35

LESLIE HUBRICHT -- THE LAND SNAILS OF SOUTH CAROLINA 41

LESLIE HUBRICHT -- ADDITIONAL LAND SNAILS FROM NORTH CAROLINA . . 44

RALPH W. DEXTER -- BENJAMIN TAPPAN, JR. (1773-1857) AS A NATURALIST AND A MALACOLOGIST. 45

RALPH M. SINCLAIR -- *CORBICULA* - SUMMARY NOTE. 50

F. WAYNE GRIMM -- ANNOTATED CHECKLIST OF THE LAND SNAILS OF MARYLAND AND THE DISTRICT OF COLUMBIA 51

NO. 42 COLUMBUS, OHIO JUNE, 1971

CONTENTS PAGE

BARRY DEAN VALENTINE and DAVID HONOR STANSBERY -- AN INTRODUCTION TO THE NAIADS OF THE LAKE TEXOMA REGION, OKLAHOMA, WITH NOTES ON THE RED RIVER FAUNA (MOLLUSCA : UNIONIDAE). 1

LESLIE HUBRICHT -- THE LAND SNAILS OF VIRGINIA 41

ANNOUNCEMENT FIRST INTERNATIONAL CONGRESS OF SYSTEMATIC AND EVOLUTIONARY BIOLOGY. 46

REPRINTS OF RARE PAPERS ON MOLLUSCA: *BRYANT WALKER (1918) SYNOPSIS AND CLASSIFICATION (continued).* *after page* 46

EDITOR
Aurèle La Rocque
Department of Geology
Ohio State University
125 S. Oval Drive
Columbus 10, Ohio

Malacological Review, 1971, 4: 273-276

AUTHOR INDEX FOR MALACOLOGICAL PERIODICALS, 1971

	page*
ADDICOTT, Warren O., U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025, U.S.A.	270
ALTENA, C.O. van Regteren, Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands	266
ANDREWS, J.D., Virginia Institute of Marine Science, Gloucester Point, Virginia, U.S.A.	265
AZUMA, Masao, 1-42 Kamiyoshihara, Nishinomiya, Hyogo, Japan 662	270
BARNACLE, G.A.S., 2 Palma Court, Manor Rd., Worthing, Sussex, U.K.	267
BEEDHAM, G.E., Department of Biological Science, North East London Polytechnic, London, U.K.	267
BEHRENS, David W., San Francisco State College, San Francisco, California, U.S.A.	271
BERG, Carl J., Jr., Department of Zoology, University of Hawaii, Honolulu, Hawaii 96822, U.S.A.	271
BIGGS, H.E.J., 48 Park Road, Bromley, Kent, U.K.	267
BLOCK, M.R., Heads Hill, Crookham Common, Newbury, Berkshire, U.K.	267
BOETERS, H. D., Rumfordstr. 42, D-8 Munich 5, West Germany	266
BOLTOVSKOY, Demetrio, Facultad de Ciencias Naturales y Museo, La Plata, Argentina	265
BOSS, Kenneth J., Museum of Comparative Zoology, Cambridge, Mass. 02138, U.S.A.	268
BRANDT, Rolf A.M., School of Tropical Medicine, 420/6 Rajvithi Road, Bangkok, Thailand	266
BRANSON, Branley A., Eastern Kentucky University, Richmond Kentucky 49675, U.S.A.	272
BROWN, D.S., Medical Research Council, c/o Zoology Department, British Museum (Natural History), London, S.W.7, U.K.	265, 269
CAIN, A.J., Department of Zoology, The University, Liverpool, L69 3BX, U.K.	267
CAMERON, R.A.D., Department of Biological Sciences, Portsmouth Polytechnic, Portsmouth, U.K.	269
CATE, Crawford, 12719 San Vicente Blvd., Los Angeles, California 90049, U.S.A.	270
CHANLEY, Paul, Shelter Island Oyster Company, Greenport, Long Island, New York 11944, U.S.A.	265
CHEATUM, E.P., Biology Department, Southern Methodist University, Dallas, Texas 75222, U.S.A.	268
CLARK, George R. II., Department of Geology, University of New Mexico, Albuquerque, New Mexico 87106, U.S.A.	270
CLENCH, W.J., 26 Rowena Street, Dorchester, Massachusetts 02124, U.S.A.	268
CROVO, M. Ellen, 2915 South West 102nd Ave., Miami, Florida 33165, U.S.A.	271

*Page numbers, this issue of *Malacological Review*. The remainder of 1971 issues of malacological journals will appear in the next volume of *Malacological Review* (Vol. 5, 1972).

	page
DANCE, S. Peter, Zoology Department, National Museum of Wales, U.K.	267
DAVIS, G.M., Academy of Natural Sciences of Philadelphia, 19th and the Parkway, Philadelphia, Pennsylvania, U.S.A.	270
DEXTER, Ralph W., Department of Biological Sciences, Kent State University, Kent, Ohio, U.S.A.	271
DUNN, V. Roger, 4727 27th Avenue South, Gulfport, Florida 33711, U.S.A.	271
DUVAL, D.M., 49 Humberstone Road, Cambridge, U.K.	267
ELWELL, Adela Skipton, Biology Department, Bemidji State College, Bemidji, Minnesota 56601, U.S.A.	265
EMERSON, William K, American Museum of Natural History, New York, N.Y. 10024, U.S.A.	268
FORCART, Lothar, Naturhistorisches Museum, Augustinergasse 2, Basel, Switzerland	266
FRANZEN, Dorothea S., Department of Biology, Illinois Wesleyan University, Bloomington, Illinois 61701, U.S.A.	268
GOULD, Stephen J., Museum of Comparative Zoology, Cambridge, Mass. 02138, U.S.A.	268
GRIMM, F. Wayne, National Museum of Natural Sciences, National Museum of Canada, Ottawa, Canada	271
HABE, Tadashige, National Science Museum, Ueno Park, Tokyo, Japan	268
HADERLIE, Eugene C., Department of Oceanography, Naval Postgraduate School, Monterey, California 93940, U.S.A.	270
HAMPSON, George R., Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543, U.S.A.	269
HAVEN, Stoner B., Department of Biological Sciences, Simon Fraser University, Burnaby 2, British Columbia, Canada	270
HUBRICHT, Leslie, 4026 35th Street, Meridian, Mississippi 39301, U.S.A.	268, 271
HUDEC, V., Donatellova Nr. 2002 (3. Et.), Praha 10 (Strasnice), C.S.S.R.	266
HUMAN, Vernon L., 2421 Clement Ave., Venice, California 90291, U.S.A.	271
HUNSAKER, Don II., P.O. Box 477, Dixon, California 95620, U.S.A.	271
HURLEY, Patricia A., Department of Biology, The University of Texas at El Paso, El Paso, Texas 79999, U.S.A.	268
ITO, Kiyoshi, National Science Museum, Ueno Park, Tokyo, Japan	268
JACOBSON, M.K., 455 Beach 139 Street, Rockaway Beach, New York 11693, U.S.A.	268
JUDD, W., Department of Zoology, University of Auckland, Auckland, New Zealand	269
JUNG, Peter, Naturhistorisches Museum, Basel Switzerland	268
KADOLSKY, Dietrich, Ippendorfer Allee 39, D-53 Bonn, German Federal Republic.	266
KANNO, Saburo, Tokyo University of Education, Tokyo, Japan	268
KEEN, A. Myra, Department of Geology, Stanford University, Stanford, California 94305, U.S.A.	271
KONINGSOR, Robert L., P.O. Box 477, Dixon, California 95620, U.S.A.	271
KOSUGE, Sadao, National Science Museum, Ueno Park, Tokyo, Japan	268
LA ROCQUE, Aurèle, 102 W. Beumont Rd., Columbus, Ohio 43214, U.S.A.	272
LAWS, Helene M., South Australian Museum, Adelaid, South Australia	265
LEZHAWA, G. [no address given]	266
MARCUS, Eveline du B.-R., Caixa Postal 6994, São Paulo, Brasil	269, 271

page

McLEAN, N., Department of Zoology, San Diego State College, San Diego, California 92115, U.S.A. 270
McMILLAN, Nora F., The Nook, Uplands Road, Bromborough, Cheshire, U.K. 267
METCALF, A.L., Department of Biology, The University of Texas at El Paso, El Paso, Texas 79999, U.S.A. 268
MOORE, Donald R., Rosenstiel School of Marine and Atmospheric Sciences, 10 Rickenbacker Casueway, University of Maimi, Florida 33149, U.S.A. 268
MORRISON, J.P.E., Division of Mollusks, U.S. National Museum, Washington, D.C. 20560, U.S.A. 268
MORTON, Brian, Department of Zoology, The University of Hong Kong, Hong Kong 269
NICOL, Patricia I., School of Zoology, University of New South Wales, Kensington, New South Wales, Australia 270
NORDSIECK, Fritz, Mahnert 4, D-5657 Haan, German Federal Republic 266
NORDSIECK, Hartmut, Pfaustrasse 10, D-722 Schwenningen, German Federal Republic 266
OBERHOLZER, G., C.S.I.R., Potchefstroom University, Transvaal, Republic of South Africa 265
O'GOWER, A.K., School of Zoology, University of New South Wales, Kensington, New South Wales, Australia 270
PAL, S.G., Department of Haematology, Royal Postgraduate Medical School, London, W.12, U.K. 269
PALLES-CLARK, M.A., Leighton Park, Reading, Berkshire, U.K. 269
PILKINGTON, Margaret C., Portobello Marine Biological Station, New Zealand 269
PURCHON, R.D., Chelsea College of Science and Technology, University of London, Hortensia Rd., London S.W.10, U.K. 269
RUSSELL, P.J.C., Portsmouth Polytechnic Marine Laboratory, Ferry Road, Hayling Island, Hants, PO11 ODG, U.K. 267
SCHILDER, Maria, [no address given] 266
SCHLICKUM, W. Richard, Hansaring 32, D-5 Köln 1, German Federal Republic 266
SINCLAIR, Ralph M., Environmental Protection Agency, Water Quality Office, National Training Center, 4676 Columbia Parkway, Cincinnati, Ohio 45226, U.S.A. 271
SMITH, Shelagh M., 3 Meadowfield Gardens, Edinburgh, U.K. 267
STANSBERY, David Honor, Faculty of Zoology, The Ohio State University, Columbus, Ohio 43210, U.S.A. 271
STOREY, R., Wolfreton School, Willerby, East Yorkshire, U.K. 269
STRAUCH, Friedrich, Geologiccess Institut der Universität, Zülpicherstr. 49, D-5 Köln, German Federal Republic 266
SUZUKI, Setsuko, Department of Medical Zoology, 406 Medical L Laboratory, USAHCZ, APO San Francisco, California, 96343, U.S.A. 270
TEMCHAROEN, Prasong, School of Tropical Medicine, 420/6 Rajvithi Road Bangkok, Thailand 266
THAYER, Charles W., Department of Geology and Geophysics, Yale University, New Haven, Connecticut, U.S.A. 269
THOMAS, Ronald Frank, Florida State University, Tallahassee, Florida 32306, U.S.A. 268
TRUC, Georges, Department des Sciences de la Terre, Université de Lyon, 86 rue Pasteur, F-69 Lyon 7e, France 266

page

TURK, Stella M., Shangri-La, Reskadinnick, Camborne, Cornwall, U.K. 267
ULMER, Martin J., Department of Zoology and Entomology,
Iowa State University, Ames Iowa 50010, U.S.A. 265
VALENTINE, Barry Dean, Faculty of Zoology, The Ohio State University,
Columbus, Ohio 43210, U.S.A. 271
VAN EEDEN, J.A., C.S.I.R., Potchefstroom University,
Transvaal, Republic of South Africa 265
VASSALLO, Marilyn T., Department of Biology, University of Victoria,
British Columbia, Canada 271
VERDCOURT, B., Spring Cottage, Kimbers Lane, Maidenhead,
Berkshire, U.K. 267
WOODWARD, F.R., Shipley Art Gallery, Gateshead, County Durham, U.K. 267
YOM-TOV, Yoram, Department of Zoology, Tel-Aviv University,
Tel-Aviv, Israel 269
YONGE, C.M., Department of Zoology, West Mains Rd., Edinburgh
EH9 3JT, Scotland, U.K. 265
ZEISSLER, Hildegard, Institut für Quartarpaläontologie, Weimar,
German Democratic Republic 267
ZILCH, Adolf, Forschungs-Institut Senckenberg, Frankfurt a. M.,
German Federal Republic 266

MALACOLOGICAL REVIEW, P. O. Box 801, Whitmore Lake, Michigan 48189, U.S.A.

PUBLICATIONS

* * * * * * *

Monographs

CHEATUM, E. P. & FULLINGTON, R. W. 1971. The aquatic and land Mollusca of Texas. I. The Recent and Pleistocene members of the gastropod family Polygyridae in Texas. The Dallas Mus. natur. Hist., Bull. 1, p 1-74, + i-vi.

DUKE, James A. *Darien mollusk dietary.* Bioenvironmental and radiological-safety feasibility studies, Atlantic-Pacific interoceanic canal. Battelle Mem. Inst., Columbus Labs., 505 King Ave., Columbus, Ohio 43201. 94 p.

JOHNSON, Richard I. 1970. The systematics and zoogeography of the Unionidae (Mollusca: Bivalvia) of the southern Atlantic slope region. *Bull. Mus. comp. Zool. Harvard Col.*, 140(6): 263-449.

ROSEWATER, Joseph. 1970(November 30). The family Littorinidae in the Indo-Pacific. *Indo-Pacif. Moll.*, 2(11): 417-506.

Pamphlets

CLAUGHER, Donald. 1970 (November). Preparation of the radula. *Papers for students No.* 5 (revised and reprinted; first published 26 July 1965), The Conchological Society of Great Britain and Ireland, p 1-6, 3pls.

OLIVER, A. P. H. 1970 (30th December). Collecting tropical marine mollusks. *Papers for students No.* 13, The Conchological Society of Great Britain and Ireland, p 1-7.

PAGET, Oliver E. 1971 (April). *List of European malacologists*, 1971. 60 p. Authorized by the Unitas Malacologica Europaea. Order from Museum of Natural History, Burgring 7, A1014, Vienna, Austria. Price: 5 International Reply Coupons, A.S. 20, US$ 1.00, £0.40.

Reviews

BRYGOO, E.-R. 1968. Les bilharzioses humaines a Madagascar. *Santé & Développement*, Imprimerie Natn., Tananarive, p 3-165.

FRANZÉN, Ake. 1970. Phylogenetic aspects of the morphology of spermatozoa and spermiogenesis. *Accad. Nazn. Lincei*, (137): 29-46.

JENÍK, J. & LOZEK, Vojen. 1970. Stepi v Cechách? *Vesmír*, 49: 113-119.

SALVAT, Bernard. 1970 (septembre). Les activités du Muséum National d'Histoire Naturelle en polynésie Française (Sciences de la mer). *Cah. Pacif.*, (14): 255-269.

YASURAOKA, K. 1970. Some recent research on the biology and control of *Oncomelania* snails in Japan. *In: Recent Adv. Res. Filariasis & Schistosomiasis in Japan*, Univ. Tokyo Press, p 291-303.

YOKOGAWA, Muneo. 1970. Schistosomiasis in Japan. *In: Recent Adv. Res. Filariasis & Schistosomiasis in Japan*, Univ. Tokoyo Press, p 231-255.

Bibliographies and Bibliographic Information

GONZALEZ, German & GONZALEZ, Domingo. 1969 (Junio). Contribucion al conocimiento de la bibliografia de las ciencias marinas del mar caribe sur. Parte I. Biologia marina y pesquera. *Lagena*, (21/22): 21-92.

JOHNSON, Richard I. 1969. Semper's *Reisen im Archipel der Philippenen, Wissenshaftliche Resultate*, 1867-1916. A complete collation. *J. Soc. Biblphy. natur. Hist.*, 5(2): 144-147.

JOHNSON, Richard I. 1969. Rossmassler's *Iconographie der Land- und Susswasser- Mollusken, Europa's*, continued by W. Kobelt, 1835-1920. A complete collation. *J. Soc. Biblphy. natur. Hist.*, 5(2): 148-151.

JOHNSON, Richard I. 1969. Pfeiffers *Noritates Conchologicae*, Series I, *Land Mollusca*, 1854-1879, and Dunker's *Novitates* Conchologicae, Series II, *Marine Mollusca*, 1862-1882. A complete collation. *J. Soc. Biblphy. natur. Hist.*, 5(3): 236-239.

JOHNSON, Richard I. 1970. Reeve, L. A. and G. B. Sowerby, *Conchologia Iconica* (1843-78): the original pattern set. *J. Soc. Biblphy. natur. Hist.*, 5(4): 288.

Research and Original Articles

ABOLINŠ-KROGIS, Anna. 1970. Electron microscope studies of the intracellular origin and formation of calcifying granules and calcium spherites in the hepatopancreas of the snail, *Helix pomatia* (L.). *Z. Zellforsch.*, 108: 501-515.

ABOLINŠ-KROGIS, Anna. 1970. Alterations in the fine structure of cytoplasmic organelles in the hepatopancreatic cells of shell-regenerating snail, *Helix pomatia* L. *Z. Zellforsch.*, 108: 516-529.

*Publications listed here do not include articles published in malacological journals (see p 225-276).

AKERLUND, GÖran. 1969. Oxygen consumption of the ampullariid snail *Marisa cornuarietis* L. in relation to body weight and temperature. Oikos, 20(2): 529-533.

ALEXANDER, C. G. 1970 (July). The osphradium of *Conus flavidus*. *Mar. Biol.*, 6(4): 236-240.

ALTENA, C. O. van Regteren. 1970. Notes on Land slugs, 16: *Deroceras* from Afghanistan, including description of *D. kandaharensis*. *Fieldiana, Zool.*, 51(15): 175-178.

ALTENA, C. O. van Regteren. 1971. On six species of marine Mollusca from Suriname, four of which are new. *Zool. Meded.*, 45(5): 75-86.

ST. ARRENBRECHT, Elisabeth Hauschteck-Jungen & JUNGEN, H., 1970 Normaler und aberranter Karyotyp von *Cepaea hortensis* (Müller) (Gastropoda). *Experientia*, 26: 1279-1281.

AZEVEDO, J. Fraga de. 1968. Factors of dispersion and maintenance of *Schistosoma haematobium* and *S. Mansoni* snail vectors. *Garcia de Orta*, Lisbon, 16(2): 147-162.

BABA, Kikutaro & HAMATANI, Iwao. 1970. Occurrences of specimens presumably identifiable with *Stiliger ornatus* Ehrenberg, 1831, at Seto, Kii, Middle Japan (Opisthobranchia: Sacoglossa). *Publs. Seto. mar. biol. Lab.*, 18(3): 199-206.

BALDWIN, Ralph B. 1970. Hindered diffusion in microporous membranes with known pore geometry. *Science*, 170: 1302-1304.

BARRY, M. M., YEVICA, P. P. & THAYER, N. H. 1971. A typical hyperplasia in the Soft-Shell Clam *Mya arenaria*. *J. invert. Pathol.*, 17: 17-27.

BAYNE, C. J., COGAN, B. H., DIAMOND, A. W., FRAZIER, J., GRUBB, P., HUTSON, A., POORE, M. E. D., STODDART, D. R. & TAYLOR, J. D. 1970. 8. Geography and ecology of Astove. *Atoll Res. Bull.*, (136): 83-99.

BAYNE, C. J., COGAN, B. H., DIAMOND, A. W., FRAZIER, J., GRUBB, P., HUTSON, A., POORE, M. E. D., STODDART, D. R. & TAYLOR, J. D. 1970. 5. Geography and Ecology of Cosmoledo Atoll. *Atoll Res. Bull.*, (136): 37-56.

BEEMAN, Robert D. 1968. The use of succinylcholine and other drugs anesthetizing or narcotizing gastropod mollusks. *Pubbl. Staz. zool. Napoli*, 36: 267-270.

BEEMAN, Robert D. 1969. An autoradiographic demonstration of stomach tooth renewal in *Phyllaplysia taylori* Dall, 1900 (Gastropoda: Opisthobranchia). *Biol. Bull.*, 136(2): 141-146.

BEEMAN, Robert D. 1970. An autoradiographic and phase contrast study of spermatogenesis in the anaspidean opisthobranch *Phyllaplysia taylori* Dall, 1900. *Arch. Zool. exp. gén.*, 111(1): 5-22.

BEEMAN, Robert D. 1970. An autoradiographic study of sperm exchange and storage in a sea hare, *Phyllaplysia taylori*, a hermaphroditic gastropod (Opisthobranchia: Anaspidia). *J. Exp. Zool.*, 175(1): 125-132.

BRATCHER, Twila & BURCH, R. D. 1970. Four new terrebrid gastropods from eastern Pacific islands. *Contr. Sci.*, (188): 1-6.

BRUGGEN, A. C. van. 1970. The terrestrial Mollusca of the Mkuzi and Ndumu game reserves, Zululand. *Lammergeyer*, (11): 58-59.

BRUGGEN, A. C. van. 1970. A contribution to the knowledge of non-marine Mollusca of South West Africa. *Zool. Meded.*, 45(4): 43-73.

BUTLER, Joseph. M. Jr., RUIZ-TIBEN, Ernesto & FERGUSON, Frederick. 1971. Evaluation of two methods for the detection of *Schistosoma mansoni* cercariae shed by *Biomphalaria glabrata*. *Amer. J. trop. Med. Hyg.*, 20(1): 157-159.

CATHER, James N. 1971. Cellular interactions in the regulation of development in annelids and molluscs. *Advan. Morphogenesis*, 9: 67-125.

CLENCH, William J. & JACOBSON, Morris K. 1971. Monograph of the Cuban genera *Emoda* and *Glyptemoda* (Mollusca: Archaeogastropoda: Helicinidae). *Bull. Mus. comp. Zool. Harvard Coll.*, 141(3): 99-130.

CONWAY, A. F., BLACK, R. E. & MORRILL, J. B. 1969. Uric acid synthesis in embryos of the pulmonate pond snail, *Limnaea palustris:* evidence for a unique pathway. *Comp. Biochem. Physiol.*, 30: 793-802.

DAY, John H., FIELD, John G. & MONTGOMERY, Mary Potts. 1971 (February). The use of numerical methods to determine the distribution of the benthic fauna across the continental shelf of North Carolina. *J. anim. Ecol.*, 40(1): 93-125.

DEMIAN, Emile S. & IBRAHIM, Abdalla M. 1968-1969. Tolerance of the snail *Marisa cornuarietis* (L.) to desiccation and to continuous submersion under laboratory conditions. *Bull. zool. Soc. Egypt*, 22: 73-88.

DEMIAN, Emile S. & IBRAHIM, Abdalla M. 1969. Feeding activities of the snail *Marisa cornuarietis* (L.) under laboratory conditions. *Proc. Sixth Arab Sci. Congr.*, (1): 145-165.

DOLPH, C. Ivar & HUMPHREY, Donald G. 1970. Chromosomes of the chiton, *Katherina tunicata*. *Trans. Amer. microsc. Soc.*, 89(2): 229-232.

DUNDEE, Dee S. & DUNDEE, Harold A. 1969. Notes concerning two Texas molluscs, *Cochliopa Texana* Pilsbry and *Lyrodes cheatumi* Pilsbry (Mollusca: Hydrobiidae). *Trans. Amer. microsc. Soc.*, 88(2): 205-210.

FALKNER, Gerhard. 1970. Beobachtungen über die Schneckennahrung des Alpenkammolchs (*Triturus cristatus carnifex Laur.*) während des Landaufenthalts. *Faun.-ökol Mitt.*, 3(9/10): 291-295.

FORK, Richard L. 1971. Laser stimulation of nerve cells in *Aplysia*. *Science*, 171: 907-908.

FRETTER, Vera & PILKINGTON, Margaret. 1971. The larval shell of some prosobranch gastropods. *J. mar. biol. Assoc. U.K.*, 51: 49-62.

GERSCHEFELD, H. M. 1971. Serotonin: Two different inhibitory actions on snail neurons. *Science*, 171: 1252-1254.

GIROD, Alberto. 1969. Ecologia e distribuzione di Alcuni Molluschi terrestri in Lombardia. *Rendiconti*, 103: 67-83.

GIROD, Alberto. 1969. Il Simposio sui "Problemi di ecologia dei Molluschi dulcicoli," Milano, 11-V-1969. *Natura*, 60(3): 228-229.

GIROD, Alberto. 1969. Malacofauna di Alcuni Fontanili a Potente di Milano. *Boll. Pesca Piscic. Idrobiol.*, 24(2): 185-235.

GREEN, Roger H. & HOBSON, Katharine D. 1970 (Autumn). Spatial and temporal structure in a temperate intertidal community, with special emphasis on *Gemma gemma* (Pelecypoda: Mollusca). *Ecology*, 51(6): 999-1011.

GROSSU, A. V. 1969. Une nourelle espèce du genre *Alopia* en Roumaine (Gastropoda, Clausiliidae). *Ann. Univ. Bucuresti, Biol. Anim.*, 18: 83-87.

GROSSU, Alexandru V. 1970. Boettgerrilla vermiformis Wiktor (Gastropoda-Pulmonata, Limacomorpha) in România. *St. Si Cerc. Biol. Ser. Zool.*, 22(4): 289-291.

GROSSU, Alexandru. 1970. Revizuirea speciilor genului *Arion* Férussac din România (Gastropoda, Arionidae). *Comun. Zool., Soc. Stiinte Biol. Repub. Soc. Romanie*, p 61-74.

GROSSU, Alexandru V. 1970. Zwei neue Arten der Gattung *Lehmannia* Heynemann aus Rumänien. *Malakol. Abh., staatl. Mus. Tierk. Dresden*, 3(10): 109-114.

HABE, Tadashige. 1970. New species of the genus *Fusinus* from Japan. *Bull. biogeogr. Soc. Jap.*, 25(2): 9-11.

HABE, Tadashige. 1970. New species of the genus *Schilderia* from the South China Sea. *Bull. biogeogr. Soc. Jap.*, 24(10): 67-69.

HABE, Tadashige. 1970. New land snail from Hokkaido, Japan. *Bull. biogeogr. Soc. Jap.*, 24(12): 79-80.

HABE, Tadashige & ITO, Kiyoshi. 1968. New species of genus *Buccinum* from off Shiretoko Peninsula, Hokkaido. *Bull. biogeogr. Soc. Jap.*, 24(9): 63-65.

HABE, Tadashige & KOSUGE, Sadao. 1970. On the C Age estimation of shell fossils taken from the Tshushima Trough and its geological significance. *Mem. natn. Sci. Mus.*, Tokyo, (3): 75-82.

HABE, Tadashige & KOSUGE, Sadao. 1970. Land and freshwater molluscs of the Tsushima Islands between Kyushu and Korea. *Mem. natn. Sci. Mus.*, Tokyo, (3): 305-320.

HUBENDICK, Bengt. 1970. Studies on Ancylidae - The Paleartic and Oriental species and form groups. *Zoologica*. 5: 1-52.

HUBENDICK, Bengt & WAREN, Anders. 1970. Smasnäckor vid Svenska Västkusten 2. Släktena *Rissoa* och *Onoba*. *Särtryck ur Göteborgs Naturhist. Mus.*, p 87-95.

JOBIN, William R. 1970. Population dynamics of aquatic snails in three farm ponds of Puerto Rico. *Amer. J. trop. Med. Hyg.*, 19(6): 1038-1048.

JOBIN, William R. 1970. Control of *Biomphalaria glabrata* in a small reservoir by fluctuation of the water level. *Amer. J. trop. Med. Hyg.*, 19(6): 1049-1054.

JOHNSON, R. J. 1971. The types and figured specimens of Unionacea (Mollusca: Bivalvia) in the British Museum (Natural History). *Bull. Brit. Mus. (natur. Hist.)*, 20(3): 75-108, 2 plates.

JUNGBLUTH, Jürgen H. 1970. Aussetzungsversuche mit der flussperlmuschel *Margaritifera margaritifera* (Linne 1758) im Schlitzerland mit Anmerkungen zum rezenten Vorkommen in Osthessen. *Philippia*, 1(1): 9-23.

JUNGBLUTH, Jürgen H. 1970. Zur Kenntnis der Gastropoden des Naturschutzparkes "Hoher Vogelsberg" I. Die Nackschnecken *Naturwiss. Abt.*, 37: 69-79.

KIM, Chung Wook. 1970 (December). Study of the analysis of snails (*Semisulcospira libertina*), the first intermediate host of *Paragonimus westermani* in the Haenam area. *Korean J. Parasitol.*, 8(3): 81-89.

KNUDSEN, Jorgen. 1970. Three bathyal prosobranchs (Gastropoda) from the southeast Asian waters. *Zool. Meded.*, 45(2): 17-23.

KURODA, Tokubei & HABE, Tadashige. 1969. Description of the new helicarionid species, *Nipponochlamys tadahashii*. *Cat. Moll. Shells Fukuoka Pref.*, p 1-4.

LOWENSTAM, Heinz A. 1971. Oral precipitation by marine gastropods (Mollusca). *Science*, 171: 487-489.

LUNETTA, João Edmundo. Fisiologia da Reprodução dos Mexilhões (*Mytilus perna* L. Mollusca Lamellibranchia). *Bol. Fac. Fil., Ciên., Letr., Univ. S. Paulo*, (324), "Zoologia e Biologia Marinha, N.S." (26): 33-111, 36 figs.

MARAZANOF, F. 1969. Contribution a l'etude ecologique des mollusques des eaux douces et saumatres des camargue. I. Milieux Espèces. *Ann. Limnol.*, 5(3): 201-323.

MARKEL, R. P. 1971 (February). Effects of thermal effluent on the epifaunal community in the Cape Cod canal. *In: Biol. Whole Organism*, Woods Hole, p 22-23.

MEIER-BROOK, Claus. 1970 (December). The effect of trematode infection upon the reproduction of a fresh water clam. *Korean J. Parasitol.*, 8(3, suppl.): 14.

MILEIKOVSKY, S. A. 1970 (August). Breeding and larval distribution of the pteropod *Clione limacina* in the north Atlantic, subarctic and north Pacific Oceans. Mar. Biol., 6(4): 317-334.

MILEIKOVSKY, S. A. 1970 (August). The influence of pollution on palagic larvae of bottom invertebrates in marine nearshore and estuarine waters. *Mar. Biol.*, 6(4): 350-356.

OBERZELLER, Edda. 1970 (November). Ergebnisse der Osterreichischen Neukaledonien-Expedition 1965. *Ann. naturhist. Mus. Wien*, 74: 325-341.

OWEN, Buzz, McLEAN, James H. & MEYER, Richard J. 1971. Hybridization in the eastern Pacific abalones (*Haliotis*). *Bull. Los Angeles Co. Mus. natur. Hist.*, (9): 1-37.

PATTERSON, C. M. Chromosomes of molluscs. *Proc. Symp. Moll.*, Mar. biol. Assoc. India, 2: 635-686.

PETERELLIS, Louisa Stripling & DUNDEE, Dee S. 1969. *Veronicella ameghini* (Gastropoda); reproductive, digestive and nervous systems. *Trans. Amer. microsc. Soc.*, 88(4): 547-558.

PONDER, W. F. 1969. Notes on two neoleptonid bivalve molluscs. *N.Z. J. mar. freshw. Res.*, 3(2): 262-272.

REY, R. & GUILLOT, L. 1969. Le niveau à *Potamides lamarki* de Saint Germain des Fossés (Allier). *Rev. Sci. Bourbonnais Centre Fr.*, p 56-66.

RICHARDS, Charles S. 1970. Genetics of a molluscan vector of *schistosomiasis*. *Nature*, 227: 806-811.

RICHARDS, Charles S. 1971. *Biomphalaria glabrata* genetics: Spire formation as a sublethal character. *J. invert. Pathol.*, 17: 53-58.

ROLLINS, Harold B., ELDREDGE, Niles & SPILLER, Judith. 1971 (April 14). Gastropods and Monoplacophora of the Solsville Member (Middle Devonian, Marcellus Formation) in the Chenango Valley, New York State. *Bull. Amer. Mus. natur. Hist.*, 144(2): 133-170.

ROWLAND, Robert W. & HOPKINS, David M. 1970. Comments on the use of *Hialella arctica* for determining cenozic sea temperatures. *In: Palaegeography, Palaeoclimatol., Palaeoecol.*, 9: 59-64.

RUIZ, Jaime Bonilla. 1969 (Diciembre). Notas sobre aspectos biologicos de las ostras. *Lagena*, (23/24): 48-68.

RUNGGER, Duri, RASTELLI, Marisa, BRAENDLE, Elisabeth & MALSBERGER, R. G. 1970. A viruslike particle associated with lesions in the muscles of *Octopus vulgaris*. *J. invert. Pathol.*, (17): 72-80.

RUTKOWSKI, Roman B. & DAVIS, Geroge M. 1970. Trypsin inhibitors in mesogastropod foot-muscle extracts. *Jap. J. Parasitol.*, 19(2): 171-181.

SACCHI, Cesare F. & GIROD, Alberto. 1968. I. Molluschi d'acqua dolce di Alcune Stazione Presso Terracini. *Boll. Pesca Piscic. Idrobiol.*, 23(2): 169-170.

SALEUDDIN, A. S. M. 1970. Electron microscopic study of the mantle of normal and regenerating *Helix*. *Can. J. Zool.*, 48(3): 409-416.

SALEUDDIN, A. S. M. 1970. Intranuclear elements in the Leydig cell of the snail *Helix*. *Can. J. Zool.*, 48(3): 614-615.

SALEUDDIN, A. S. M. 1971. Fine structure of normal and regenerated shell of *Helix*. *Can. J. Zool.*, 49(1): 37-41.

SALEUDDIN, A. S. M. & HARE, P. E. 1970. Amino acid compositions of normal and regenerated shell of *Helix*. *Can. J. Zool.*, 48(4): 885-888.

SALEUDDIN, A. S. M., MIRADA, Eduardo, LOSADA, Freddy & WILBUR, Karl M. 1970. Electrophoretic studies on blood and tissue proteins of normal and regenerating *Ampullarium glaucus* (Gastropoda). *Can. J. Zool.*, 48(3): 495-499.

SALVAT, B. 1970. Biogéographie malacologique de la Polynésie à la lumière des récentes recherches sur l'histoire géologique des îles hautes et des atolls de cette région. *Sec. Congr. Malak. ital., Gènes*, 2 p.

SALVAT, B. 1970. Etudes quantitives (comptages et biomasses) sur les mollusques récifaux de l'atoll de Fangataufa (Tuamotu - Polynésie). *Cah. Pacif.*, (14): 1-58, 10 photographs.

SALVAT, B. 1971. Oceanographie - Evaluation quantative totale de la Faune benthique de la bordure lagunaire d'un atoll de Polynésie Française. *C. hebd. Séanc. Acad. Sci.*, (272): 211-214.

SALVAT, B. & EHRHARDT, J. P. 1970. Mollusques de l'île Clipperton. *Bull. Mus. nat. Hist. natur.*, 42(1): 223-231.

SCHULTZ, Gerald E. & CHEATUM, Elmer P. 1970. *Bison occidentalis* and associated invertibrates from the late Wisconsin of Randall County, Texas. *J. Paleontol.*, 44(5): 836-850.

SCHWABL, Gerda & MURRAY, James. 1970. Electrophoresis of proteins in natural populations of *Partula* (Gastropoda). *Evolution*, 24(2): 424-430.

SMITH, Brian J. & LONG, David C. 1970. Plans for a proposed census of non-marine molluscs in Victoria. *Vict. Natur.*, 87(6): 169-170.

STARMUHLNER, Ferdinand. 1970. Ergebnisse der österreichischen Neukaledonien-Expedition 1965. *Ann. naturhistor. Mus. Wien*, 74: 289-324.

STIGLINGH, Ina & VAN EEDEN, J. A. 1970. Free amino acids in the haemolymph of *Bulinus* (Bulinus) *tropicus* (Krauss). A preliminary report. *Wetenskaplike Bydraes Van Die P.V. vir C.H.O.* [Potchefstroom Univ. Christ. Higher Ed., Potchefstroom, Transvaal, Rep. S. Afr.], Reeks B(Natuurwetenskappe), (13): 1-4.

STRAUCH, Friedrich. 1970. Die Thule- Landbrücke als Wanderweg und Faunenscheide zwischen Atlantic und skandik im Tertiär. *Geol. Rundschau*, 60(1): 381-417.

STREIFF, W. & LE BRETON, J. 1970. Etude endocrinologique des facteurs régissant la morphogenèse et la regression du pénis chez un Mollusque Prosobranchia gonochorique *Littorina littrea L. C. r. hebd. Séanc. Acad. Sci.*, 270: 547-549.

STREIFF, W. & LE BRETON, J. 1970. Etude comparée en culture *in vitro* des facteurs responsables de la morphogenèse et de la régression du tractus génital mâle externe chez deux Mollusques Gastéropodes Prosobranches: *Crepidula fornicata* Phil. (espèce protandre) et *Littorina* littoreal (espèce gonochorique). *C. r. hebd. Séanc. Acad. Sci.*, 270: 632-634.

THIRIOT-QUIEVREUX, C. 1970. Transformations histologiques los de la metamorphose chez *Cymbulia peroni* de Blainville (Mollusca, Opisthobranchia). Z. Morph. Tiere, 67: 106-117.

THOMPSON, Fred G. 1969. Some hydrobiid snails from Georgia and Florida *Quart. J. Florida. Acad. Sci.*, 32(4): 241-265.

TREVALLION, A., ANSELL, A. D., SIVADAS, P. & NARAYANAN, B. 1970. A preliminary account of two sandy beaches in South West India. *Mar. Biol.*, 6(3): 268-279.

UMIJI, Sati. Neurosecreção em *Mytilus perna*. (Mollusco - Lamelibrânquio). *Bol. Fac. Fil., Ciên., Letr., Univ. S. Paulo*, (324) "Zoologia e Biologia Marinha, N.S." (26): 181-254, 26 figs.
VERDECOURT, Vernard. 1970. The genus *Cerastua* Strand (Mollusca - Enidae) in the Congo Republic, Burundi and Rwanda. *Rev. Zool. Bot. Afr.*, 82(1-2): 14-33.
VERMEIJ, Geerat J. 1971. Gastropod evolution and morphological diversity in relation to shell geometry. *J. Zool.*, 163(1): 15-23.
WADDINGTON, C. H. & COWE, R. J. 1969. Computer simulation of a molluscan pigmentation pattern. *J. theoret. Biol.*, 25: 219-225.
WISE, Sherwood W. Jr. 1969. Study of molluscan shell ultrastructures. *In: Scanning Electron Microscopy*, p 205-216.
WISE, Sherwood W. Jr. 1970. Microarchitecture and mode of formation of nacre (Mother-of-Pearl) in pelecypods, gastropods, and cephalopods. *Eclogae Geol. Helvet.*, 63(3): 775-797.
WISE, Sherwood W. Jr. 1970. Scleractinian coral exoskeletons: Surface microarchitecture and attachment scar patterns. *Science*, 169: 978-980.
YOM-TOV, Yoram. 1970. The effect of predation on population densities of some desert snails. *Ecology*, 51(5): 907-911.
ZEISSLER, Hildegard. 1969. Schnecken kleiner Felsbiotope im nördlichen Hainich. *Abh. Ber. Naturkd. Vorgesch. Magdeburg*, 11(5): 171-177.
ZEISSLER, Hildegard. 1970. Azeca menkeana und andere Schnecken bei Hohenfelden/Kreis Weimar. *Malakol. Abh., staatl. Mus. Tierk. Dresden*, 3(1): 1-5.
ZEISSLER, Hildegard. 1970. Schnecken in einigen Nebengründen des Mühltales bei Jena. *Malakol. Abh., staatl. Mus. Tierk. Dresden*, 3(2): 7-13.
ZEISSLER, Hildegard. 1970. Konchylien aus dem holozänen Travertin Körner bei Mühlhausen in Thüringen (Aufschluss an der Bergmühle). *Malakol. Abh., staatl. Mus. Tierk. Dresden*, 3(4): 33-40.
ZEISSLER, Hildegard. 1970. Die Schnecken im nördlichen Hainich zwischen dem Bahnhof Heyerode und dem Schlossberg bei Nazza. *Malakol. Abh., staatl. Mus. Tierk. Dresden*, 3(6): 43-70.
ZEISSLER, Hildegard. 1970. Eine Konchylien - Probenreihe aus dem interglazien Travertin von Burgtonna bei Bad Langensalza. *Malakol. Abh., staatl. Mus. Tierk. Dresden*, 3(9): 99-108.
ZEISSLER, Hildegard. 1970. Konchylien aus einem vorübergehenden Aufschluss am Markt von Weimar. *Malakol. Abh., staatl. Mus. Tierk. Dresden*, 3(11): 115-121.

Technical Notes and Comments

BABA, Kikutaro. 1970. List of the Aplysiidae from Japan. *Collecting & Breed.*, 32(3): 94-96. [In Japanese]
BABA, Kikutaro. 1970 (November). Additional notes on *Stylocheilus spp. from Japan*. *Collecting & Breed.*, 32(11): 376-377.
CLARKE, Arthur H. 1970. Sphaeriidae in Mollusca and Insecta: Proposal for rectification of homonymy. Z.N. (S.) 1892. *Bull. zool. Nomencl.*, 26(5/6): 235-237.
GROSSU, Al. 1970 (Spring). Two species recently discovered invading the Black Sea. *Of Sea and Shore*, 1: 43-44.
JOBIN, William R. 1968. Rationale for selecting molluscicides for Bilharzia control programs. *Pub. Hlth. Reps.*, 83(7): 594-596.
NICOL, David. 1970 (5 June). Antarcitc pelecypod faunal peculiarities. *Science*, 168(3936): 1248-1249.
REESE, K. M. 1971 (February 15). Tiny octopus is deadly. *Chem. & Engin. News*, 49(7): 100.

Progress Reports

CARRIKER, Melbourne R. 1971 (February). *Biology of the whole organism*. Year Round Research and Training in the Cape Cod Coastal Ecosystems, Emphasis on the Systematics and Ecology of Whole Estuarine and Marine Organisms, Eight Ann. Rep. on Prog., Sept. 1969-August 1970, Contr. No. 240, Systematics-Ecology Program, Mar, Biol. Lab., Woods Hole, Mass. 02543, U.S.A. 42 p.

Malacological Journals

Argamon. Vol. 1, No. 1. July 1970. P.O. Box 9216 Haifa, Israel. p 1-36. -- Vol. 1, No. 2. December 1970, p 37-72.
Communicaciones de la Sociedad Malacológica del Uruguay. Vol. 2, No. 18. Abril 1970. Casilla de Correo No. 1401, Montevideo, Uruguay. p 407-435 + i-xxii.
Conchiglie. Anno 6, No. 1-2. Gennaio-febbraio 1970. Via De Sanctis, 73, Milano, Italy. p 1-16. -- Anno 6, No. 3-4. Marzo-aprile 1970. p 17-32. - Supplemento. p 29-45. -- Anno 6, No. 5-6. Maggio-giugno 1970. p 33-60. -- Anno 6, No. 7-8. Luglio-agosto 1970. p 61-104. -- Anno 6, No. 9-10. Settembre-ottobre 1970. p 105-144. -- Anno 6, No. 11-12. Novembre-dicembre 1970. p 1-87 [Atti della Unione Malacologica Italiana, Anno 1, fasc. 1].
Journal de Conchyliologie. Vol. 108, No. 2. 30 juin 1970. 55 Prince Albert St., Mosman, N.S.W. 2088, Australia. p 35-60. -- Vol. 108, No. 3. 30 septembre 1970. p 61-85.
La Conchiglia! Anno , No. 1. Gennaio 1970. Via Tomacelli 146-IV P, 00186 Roma, Italy. p 1-15. -- Anno 2, No. 2. Febbraio 1970. p 1-15. -- Anno 2, No. 3. Marzo 1970. p 1-15. -- Anno 2, No. 4. Aprile 1970. p 1-15. -- Anno 2, No. 5. Maggio 1970. p 1-15. -- Anno 2, No. 6. Giugno 1970. p 1-15. -- Anno 2, 7-8. Luglio-Ag. 1970. p 1-23. -- Anno 2, No. 9. Settembre 1970. p 1-15. -- Anno 2, No. 10. Ottobre 1970. p 1-15. -- Anno 2, No. 11-12. Dicembre 1970. p 1-23.

Malacologia, Vol. 10, No. 2. December 1970. c/o Museum of Zoology, University of Michigan, Ann Arbor, Michigan 48104, U.S.A. p 283-478 + i-ix + 7 p.

Malacological Review. Vol. 3, 2nd part. 1970. P.O. Box 801, Whitmore Lake, Michigan 48189, U.S.A. p 103-192.

Proceedings of the Malacological Society of London. Vol. 39, Part 2/3. December 1970. c/o Blackwell Scientific Publications, Ltd., 5 Alfred Street, Oxford, England. p 93-247.

Proceedings of the National Shellfisheries Association. [1970]. Volume 61. June 1971. c/o National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Marine Extension-Shellfish, Oxford, Maryland 21654, U.S.A. p 1-109 + i-vi.

Sterkiana. No. 37. March 1970. 102. W. Beaumont Rd., Columbus, Ohio 43214, U.S.A. 50 p. -- No. 38. June 1970. 50 p. -- No. 39. September 1970. 51p. -- No. 40. December 1970. 62 p.

The American Malacological Union, Inc., Annual Reports. Bull. No. 37. 1 December 1970. 3957 Marlow Court, Seaford, New York 11783, U.S.A. p 1-112.

The Echo. 7 March 1971. 1217 Waller St., San Francisco, California 94117, U.S.A. p 1-77.

Newsletters

Achatina. No. 2. 1 February 1971. A newsletter of African Non-Marine Malacology. c/o Section des Invertébrés non-Insectes, Musée Royal de l'Afrique Centrale, 1980 Tervuren, Belgium. p 19-36.

Australian Newsletter. No. 12 (New Series). 31st Januray 1971. Malacological Society of Australia. c/o The Australian Museum, College Street, Sydney, N.S.W. 2000, Australia. 12 p.

Bulletin mensuel. 3e année, no. 12. Décembre 1970. Association belge de Malacologie, de Conchyliologie et de Paléontologie. Avenue des Mantes, 10, 1170 Bruxelles, Belgium. p 157-176.

Bulletin mensuel d'information. 4e année, no. 2. Février 1971. Association belge de Malacologie, de Conchyliologie et de Paléontologie. Avenue des Mantes, 10, 1170 Bruxelles, Belgium. p 1-10. - Complement, p 1-30. -- 4e année, no. 3. Mars 1971. p 1-11. - Complement, p 1-34. -- 4e année, no. 4. Avril 1971. p 1-4. - Complement, p 1-38. -- 4e année, no. 5. Mai 1971. p 1-7.

The Conchologists' Newsletter. No. 35. December 1970. The Conchological Society of Great Britain and Ireland. 82 Chelsea Gardens, Chelsea Bridge Road, London, S.W. 1, England. p 177-190. -- No. 36. March 1971. p 191-203.

Corbicula Communications. No. 2. 12 February 1971. c/o National Training Center, 4676 Columbia Parkway, Cincinnati, Ohio 45226, U.S.A.

Correspondentieblad van de Nederlandse Malacologische Vereniging. No. 140. Februari 1971. c/o Rijksmuseum van Natuurlijke Historie, Raamsteeg 2, Leiden, Netherlands. p 1577-1596. -- No. 141. Maart 1971. p 1597-1602.

Mitteilungen der Deutschen Malakozoologischen Gesellschaft. Band 2, Nummer 18. Dezember 1970. Schloss Rosenstein, Stuttgart 1, German Federal Republic. p 219-253. -- Band 2, Nummer 19. p 255-276.

Newsletter of The American Malacological Union, Inc. April 1971. 3957 Marlow Court, Seaford, New York 11783, U.S.A.

Of sea and shore. Vol. 1, No. 3. Fall 1970. P.O. Box 33, Port Gamble, Washington 98364, U.S.A. p 109-160. -- Vol. 1, No. 4. Winter 1970. p 161-212. -- Vol. 2, No. 1. Spring 1971. p 1-50.

VOLUME 4 1971

INDEX TO SCIENTIFIC NAMES

Achatinellidae, 177
Acropora, 7
Actinopyga, 9, 10
  serratidens, 9, 10
Aillyidae, 175, 178, 196
alata, Proptera, 127, 128
albicilla, Nerita, 4, 14
alveolata, Engina, 4
anceps, Helisoma, 21-24
Aneitea, 25, 26, 179, 197
Anodonta, 127-129
  corpulenta, 127-129
  grandis, 127, 129
  imbecillis, 127-129
  suborbiculata, 127, 129
Aplysia, 176
aprica, Catinella, 135,170
aprica, Quickella, 171
Arca, 7, 9, 14
  plicata, 9, 14
Archaeogastropoda, 14
Arcidae, 14
arenaria, Catinella, 170, 171, 190, 191
arenaria, Quickella, 171, 190
Asaphis, 4, 15
  deflorata, 4, 15
asperella, Chama, 9, 15
Astralium, 7, 8, 14
  petrosum, 7, 8, 14
Athoracophoridae, 25, 26, 175-179
atra, Halodeima, 5-9
Atyidae, 14
Atys, 14
  parallela, 14
aulacospira, Erinna, 209, 210
auricularia, Radix, 210
auriculatus, Modiolus, 5, 6, 8, 14
Austropeplea, 209, 210
  ollula, 210
Austrosuccinea, 183, 195
baldwini, Catinella, 190
Basommatophora, 14, 131, 133, 169, 176-178, 199
bensoni, Quickia, 132, 133, 136, 164-168, 170, 191-193
bensoni, Succinea, 165
bernardii, Camptonyx, 181
bernardii, Succinea, 181
boissieri, Sphincterochila, 121-126
Boninosuccinea, 136, 182, 195
Brachispira, 182
Brachyspira, 195
brasiliensis, Neohyalimax, 187
brasiliensis, Omalonyx, 187
Buccinidae, 4, 14
bufonia, Bursa, 10, 14
Bulinus, 27
  tropicus, 27
Burchella, 131, 167, 168, 191, 192, 194, 199
  calcuttensis, 167, 168, 191, 192
Bursa, 10, 14
  bufonia, 10, 14
Bursidae, 14
calcaratus, Trochus, 8, 14
Calcisuccinea, 183, 184, 195
calcuttensis, Burchella, 167, 168, 191, 192
calcuttensis, Quickia, 132, 133, 136, 166-168, 170, 172
campestris, Succinea, 135, 171, 175, 183
Camptonyx, 132, 136, 181, 189, 195, 199
  bernardii, 181
cancellata, Ricinula, 8, 14
Cantharus, 4, 8, 12, 14
  fumosus, 4, 14
  undosus, 8, 12, 14
caputserpentis, Cypraea, 1, 4-9, 14
Cardiidae, 15
Cardium, 7
  fragum, 7
carinata, Erinna, 181
carinata, Lantzia, 181
Carunculina, 128, 129
  parva, 129
Catinella, 131-135, 153, 157-163, 170, 171, 180, 185, 189-199
  arenaria, 170, 171, 190, 191
  aprica, 135, 170
  baldwini, 190
  putamen, 132, 133, 135, 157-159, 170, 171, 180
  rotundata, 135, 170, 171, 185, 190
  rubida, 190

texana, 135, 170
vagans, 190
vermeta, 132, 133, 135, 159-163, 170, 171, 190
Catinellinae, 131, 155, 169, 170, 171, 188, 193, 195, 197, 198
Caulerpa, 10
Cepaea, 49
Cephalaspidea, 14
Cephalopoda, 15
Cerithiidae, 5, 14
Cerithium, 5-10, 14
columna, 5, 8, 14
lineatum, 6, 8, 14
nesioticum, 5, 8, 10, 14
piperitum, 5, 14
sinensis, 5-8, 14
chaldaeus, Virroconus, 14
chaldeus, Conus, 7, 9, 14
Chama, 5-11, 15
asperella, 9, 15
imbricata, 5-11, 15
Chamidae, 15
chinensis, Neosuccinea, 187, 188
chlorostomum, Cymatium, 9, 14
chlorostomum, Lampusia, 14
Cincindelidae, 51
cleopatrae, Oxyloma, 132-135, 145-147 172, 175, 186, 187
coccinea, Littorina, 7, 8, 12, 14
Codakia, 4, 9, 15
divergens, 4, 9, 15
tigerina, 9, 15
Columbella, 8, 14
versicolor, 8, 14
columella, Pseudosuccinea, 210
columna, Cerithium, 5, 8, 14
complanata, Lasmigona, 127, 129
concinna, Nassarius, 5, 14
concisa, Quickia, 191, 192, 193
concordialis, Succinea, 135, 171, 175, 183
Conidae, 7, 9, 14
connollyi, Oxyloma, 186
Conus, 4-14
chaldeus, 7, 9, 14
coronatus, 4, 10, 14
ebraeus, 4, 5, 7, 9, 14
flavidus, 7, 9, 10, 14
lividus, 10, 14
nanus, 8, 12, 13
pulicarius, 7, 14
sponsalis, 8, 11, 12, 14
Corbicula, 127-129
manilensis, 127-129
cordatum, Pleurobema, 17-20
coronatus, Conus, 4, 10, 14
coronatus, Virroconus, 14
corpulenta, Anodonta, 127-129
Cymatiidae, 5, 14
Cymatium, 5, 9, 14
chlorostomum, 9, 14
muricinum, 5, 14
Cypraea, 1, 4-9, 14, 50
caputserpentis, 5, 9, 14
moneta, 7, 8, 14
obvelata, 5, 14
tigris schilderiana, 50
Cypraeacea, 51
Cypraeidae, 14, 51
deflorata, Asaphis, 4, 15
delalandei, Succinea, 183
Desmosuccinea, 183, 184, 195
Desmousuccinea, 184
difficilis, Microthele, 8, 10
divergens, Codakia, 4, 9, 15
donaciformis, Truncilla, 129
Drupa, 5-14
elata, 7, 10, 12, 14
fiscella, 9, 14
grossularia, 9, 10, 14
horrida, 7-9, 14
morum, 5-9, 12, 14
ricinus, 5, 7, 9, 14
dunkeri, Oxyloma, 186
dunkeri, Succinea, 186
duryi, Helisoma, 21-24
ebraeus, Conus, 4, 5, 7, 9, 14
ebraeus, Virroconus, 14
effusa, Oxyloma, 186
effusa, Succinea, 186
Elasmognatha, 178
elata, Drupa, 7, 10, 12, 14
emarginata, Stagnicola, 177
Endodontinae, 177
Engina, 4
alveolata, 4
Entomotaeniata, 14
Errina, 181, 209, 210
aulacospira, 209, 210
carinata, 181
newcombi, 209, 210
Eulamellibranchia, 15
Euthyneura, 133, 169, 195

Fasciolariidae, 14
felina, Omalonyx, 132, 133, 135, 148, 149, 151, 172, 175, 177, 187
Filibranchia, 14
fiscella, Drupa, 9, 14
flavidus, Conus, 7, 9, 10, 14
flavidus, Virgiconus, 14
Fossaria, 210
truncatula, 210
modicella rustica, 210
fragilis, Leptodea, 128
fragum, Cardium, 7
fragum, Fragum, 15
Fragum, 15
fragum, 15
fumosus, Cantharus, 4, 14
gabbi, Quickella, 171
Gafrarium, 4, 6, 8, 10, 15
pectinatum, 4, 6, 8, 10, 15
Gastropoda, 14, 121, 195
gibberulus, Strombus, 8, 10, 14
girata, Succinea, 171
graeffei, Triboniophorus, 25, 26
grandinatus, Tectarius, 8, 12, 13
grandis, Anodonta, 127, 129
granulata, Morula, 5, 10, 14
gravelyi, Quickia, 136, 170, 192
greeri, Succinea, 171, 175
groenlandica, Oxyloma, 186
grossularia, Drupa, 9, 10, 14
grosvenori, Succinea, 135, 171, 175, 197
Gutturnium, 14
muricinum, 14
Halodeima, 5-9
atra, 5-9
hilla, 8
haydeni, Neoxyloma, 172
haydeni, Oxyloma, 172
Helisiga, 131, 135, 181, 184, 193, 195, 198
sanctaehelenae, 135, 184, 198
Helisoma, 21-24
anceps, 21-24
duryi, 21-24
scalare, 21-24
trivolvis, 21-24
Helix, 125
pomatia, 125
Heterurethra, 25, 131-133, 175, 178, 195, 196, 197, 199
Heysuccinea, 195
hilla, Halodeima, 8
Hipponicidae, 14
Hipponyx, 8, 10, 14
pilosus, 8, 10, 14
hirasei, Oxyloma, 172
Holothuria, 8, 10
leucospilota, 10
pervicax, 8, 10
horrida, Drupa, 7-9, 14
horticola, Succinea, 183
Hyalimax, 131-135, 142-145, 181, 184, 185, 187, 193-195, 197, 199
maillardi, 132, 133, 135, 142-145, 185, 199
mauritianus, 185
Hydrotropa, 186, 195
pfeifferi, 186
imbecillis, Anodonta, 127-129
imbricata, Chama, 5-11, 15
indiana, Succinea, 183
indica, Oxyloma, 187
indica, Succinea, 187
Indosuccinea, 131-136, 152-157, 172, 175, 181, 188, 189, 193-195
khandalla, 132-135, 152-157, 172, 175, 188, 189
semiserica, 154, 188
semiserica khandalla, 154, 188
semiserica sthulasiras, 153, 188
Isognomon, 5-10, 15
isognomum, 5, 6, 15
sulcata, 8-10, 15
Isognomonidae, 15
isognomum, Isognomon, 5, 6, 15
japonica, Oxyloma, 172, 175
Jarava, 185, 195
khandalla, Indosuccinea, 132-135, 152-157, 172, 175, 188, 189
khandalla, Indosuccinea semiserica, 154, 188
kofui, Neosuccinea, 132, 133, 135, 136, 150, 151, 180, 187, 188
kuntziana, Succinea, 132, 133, 135 139-141, 171, 175, 183-185
kwansae, Oxyloma, 172
laevissima, Leptodea, 128
laevissima, Proptera, 128
Lambis, 8, 14
truncata, 8, 14
Lamellibranchiata, 14
Lampusia, 14
chlorostomum, 14
Lantzia, 181

carinata, 181
Lasmigona, 127, 129
complanata, 127, 129
Latirus, 8, 9, 12, 13
nodatus, 8, 9, 12, 13
lauta sphaerica, Succinea, 172
lauta, Succinea, 135, 172, 184, 198
Laxisuccinea, 182
lejavai, Oxyloma, 186
Leptodea, 128
fragilis, 128
laevissima, 128
leucospilota, Holothuria, 10
Limnea, 210
volutata, 210
lineatum, Cerithium, 6, 8, 14
Lithotis, 132-136, 155-157, 172, 175, 176, 181, 184, 187, 189, 193-195, 198, 199
rupicola, 132-136, 155-157, 172, 175, 181, 189
tumida, 189
litterata, Strigatella, 8-10, 14
Littorina, 7, 8, 12, 14
coccinea, 7, 8, 12, 14
Littorinidae, 14
lividus, Conus, 10, 14
lividus, Virroconus, 14
Lucinidae, 15
luteola, Succinea, 135, 171, 175
Lymnaea, 210
volutata, 210
Lymnaeidae, 181, 209
Lyncina, 50
schilderorum, 50
maculata, Pinctada, 8, 10, 15
maillardi, Hyalimax, 132, 133, 135, 142-145, 185, 199
manilensis, Corbicula, 127-129
marochiensis, Natica, 9, 14
Martesia, 207, 208
striata, 207, 208
mauritianus, Hyalimax, 185
maxima, Tridacna, 5, 15
maximus, Vermetus, 5-9, 12-14
Mediappendix, 131, 161, 189, 195, 199
Melaleuca, 25
Mesogastropoda, 14
Mesurethra, 133, 196, 197
Microthele, 8, 10
difficilis, 8, 10
Milax, 25
miliaris, Conus, 7, 9, 14
miliaris, Virroconus, 14
Millepora, 10
Mitridae, 14
modicella rustica, Fossaria, 210
Modiolus, 5, 6, 8, 14
auriculatus, 5, 6, 8, 14
moneta, Cypraea, 7, 8, 14
Montipora, 7
morio, Nerita, 4, 10, 12, 14
Morula, 5, 10, 14
granulata, 5, 10, 14
morum, Drupa, 5-9, 12, 14
Muricidae, 5, 7, 9, 14
muricinum, Cymatium, 5, 14
muricinum, Gutturinium, 14
mutabilis, Strombus, 10, 14
Mytilidae, 14
Mytilus, 10, 14
nanus, Conus, 8, 12, 13
Nassaridae, 5, 14
Nassarius, 5, 14
concinna, 5, 14
nassatula, Peristernia, 7-14
Natica, 9, 14
marochiensis, 9, 14
Naticidae, 14
Neogastropoda, 14
Neohyalimax, 177, 187, 194, 195
brasiliensis, 187
Neosuccinea 132-136, 150, 151, 181, 187, 188, 193-195, 198
chinensis, 187, 188
kofui, 132, 133, 135, 136, 150, 151, 180, 187, 188
Neoxyloma, 132, 172, 186, 194, 195, 198, 199
haydeni, 172
retusa, 172, 186
salleana, 172
Nerita, 4-14
albicilla, 4, 14
morio, 4, 10, 12, 14
plicata, 4-14
polita, 9, 14
Neritidae, 14
nesioticum, Cerithium, 5, 8, 10, 14
newcombi, Erinna, 209, 210
nodatus, Latirus, 8, 9, 12, 13
Notaspidea, 14
Novisuccinea, 182-185
Novosuccinea, 184

oblonga, Succinea, 171, 172, 175, 184
oblonga, Succinella, 184
oblongum, Trapezium, 8, 15
obvelata, Cypraea, 5, 14
Octopus, 5, 15
ollula, Austropeplea, 210
Omalonyx, 131-136, 148, 149, 151, 172, 175, 177, 181, 187, 189, 193-195, 197, 199
brasiliensis, 187
felina, 132, 133, 135, 148, 149, 151, 172, 175, 177, 187
patera, 187
unguis, 177
Onchidiidae, 178
Opisthobranchia, 131, 133, 176-178, 199
Orthurethra, 133, 177, 178, 196, 197
ovalis, Succinea, 135, 172, 175, 177, 183, 197
Oxyloma, 131-136, 144-147, 172, 175, 177, 180, 182, 184, 186, 193-195 198, 199
cleopatrae, 132-135, 145-147, 172, 175, 186, 187
connollyi, 186
dunkeri, 186
effusa, 186
groenlandica, 186
haydeni, 172
hirasei, 172
indica, 187
japonica, 172, 175
kwansae, 172
lejavai, 186
patentissima, 186
pfeifferi, 186
pseudomalonyx, 186
retusa, 135, 172, 186
salleana, 135, 172
sarsi, 172, 177
Papusuccinea, 183, 195
Papyrotheca, 182
parallela, Atys, 14
parva, Carunculina, 128, 129
Patella, 8, 9, 12, 14
stellaeformis, 8, 9, 14
Patellidae, 14
patentissima, Oxyloma, 186
patera, Omalonyx, 187
pectinatum, Gafrarium, 4, 6, 8, 10, 15
Peristernia, 7-14
nassatula, 7-14
pervicax, Holothuria, 8, 10
petitiana, Vanikoro, 8, 14
petrosum, Astralium, 7, 8, 14
pfeifferi, Hydrotropa, 186
pfeifferi, Oxyloma, 186
pfeifferi, Succinea, 184
Pholadidae, 207
Phylloxera, 51
pilosus, Hipponyx, 8, 10, 14
Pinctada, 7, 8, 10, 15
maculata, 8, 10, 15
piperitium, Cerithium, 5, 14
Pleurobema, 17-20
cordatum, 17-20
plicata, Arca, 9, 14
plicata, Nerita, 4-14
Pocillopora, 10
Pocockiella, 10
polita, Nerita, 9, 14
Polygyridae, 169
pomatia, Helix, 125
Porites, 7
producta, Pseudisidora, 209, 210
propinqua, Pyramidella, 10, 14
Proptera, 127, 128
alata, 127, 128
laevissima, 128
Pseudisidora, 209, 210
producta, 209, 210
pseudomalonyx, Oxyloma, 186
Pseudosuccinea, 210
columella, 210
Pteriidae, 15
publicarius, Conus, 7, 14
publicarius, Puncticulis, 14
Pulmonata, 133
Puncticulis, 14
pulicarius, 14
putamen, Catinella, 132, 133, 135, 157-159, 170, 171, 190
putris, Succinea, 132-139, 172, 175-177 182, 185, 198
Pyramidella, 10, 14
propinqua, 10, 14
Pyramidellidae, 14
Pyrenidae, 14
quadrula, Quadrula, 128
Quadrula, 128
quadrula, 128
Quickella, 159, 161, 171, 190, 194, 195, 198, 199
aprica, 171
arenaria, 171, 190

gabbi, 171
texana, 171
vagans, 161, 171
vermeta, 159, 171
Quickia, 131-133, 136, 157, 162-168, 170, 180, 181, 189-194, 197-199
bensoni, 132, 133, 136, 164-168, 170, 191-193
calcuttensis, 132, 133, 136, 166-168, 170, 192
concisa, 191, 192, 193
gravelyi, 136, 170, 192
spurca, 132, 133, 136, 162-165, 170, 191-193
Quickinae, 198
Radix, 209, 210
auricularia, 210
Rathousiidae, 178
reticulata, *Venus*, 4, 8, 15
retusa, *Neoxyloma*, 172, 186
retusa, *Oxyloma*, 135, 172, 186
Ricinula, 8, 14
cancellata, 8, 14
ricinus, *Drupa*, 5, 7, 9, 14
robusta, *Tellina*, 15
rotundata, *Catinella*, 135, 170, 171, 185, 190
rubida, *Catinella*, 190
rugosa, *Tellina*, 4, 15
rupicola, *Lithotis*, 132-136, 155-157, 172, 175, 181, 189
rustica, *Fossaria modicella*, 210
salleana, *Neoxyloma*, 172
salleana, *Oxyloma*, 135, 172
sanctaehelenae, *Helisiga*, 135, 184, 198
sanctaehelenae, *Succinea*, 185
Sanguinolariidae, 15
sanibelensis, *Succinea*, 171, 175
sarsi, *Oxyloma*, 172, 177
scalare, *Helisoma*, 21-24
schilderi, *Zoila*, 50
Schilderia, 50
schilderiana, *Cypraea tigris*, 50
schilderorum, *Lyncina*, 50
Scleroderma, 10
scobinata, *Tellina*, 4, 15
seetzeni, *Trochoidea*, 121-126
seetzeni, *Xerocrassa*, 121
semiserica khandalla, *Indosuccinea*, 154, 188
semiserica sthulasiras, *Indosuccinea*, 153, 188
semiserica, *Indosuccinea*, 154, 188
semiserica, *Succinea*, 154
serratidens, *Actinopyga*, 9, 10
setosus, *Turbo*, 8, 12, 14
Sigmurethra, 133, 178, 196, 197
sinensis, *Cerithium*, 5-8, 14
Siphonaria, 4, 6, 14
Siphonariidae, 14
Soleolifera, 178, 199
sphaerica, *Succinea lauta*, 172
Sphaeriidae, 211
Sphincterochila, 121-126
boissieri, 121-126
sponsalis, *Conus*, 8, 11, 12, 14
sponsalis, *Virroconus*, 14
spurca, *Quickia*, 132, 133, 136, 162-165, 170, 191-193
spurca, *Succinea*, 163
Stagnicola, 177
emarginata, 177
stellaeformis, *Patella*, 8, 9, 14
stelliferus, *Succinoides*, 182, 188
sthulasiras, *Indosuccinea semiserica*, 153, 188
stretchiana, *Succinea*, 171, 175
striata, *Martesia*, 207, 208
Strigatella, 8-10, 14
litterata, 8-10, 14
Strombidae, 14
Strombus, 8, 10, 14
gibberulus, 8, 10, 14
mutabilis, 10, 14
strubelli, *Succinea*, 135, 171
Stylommatophora, 132, 134, 175-180, 195, 196, 199
suborbiculata, *Anodonta*, 127, 129
Succinea, 131-201
bensoni, 165
bernardii, 181
campestris, 135, 171, 175, 183
concordialis, 135, 171, 175, 183
delalandei, 183
dunkeri, 186
effusa, 186
girata, 171
greeri, 171, 175
grosvenori, 135, 171, 175, 197
horticola, 183
indiana, 183
indica, 187
kuntziana, 132, 133, 135, 139-141, 171, 175, 183-185

lauta, 135, 172, 184, 198
lauta sphaerica, 172
luteola, 135, 171, 175
oblonga, 171, 172, 175, 184
ovalis, 135, 172, 175, 177, 183, 197
pfeifferi, 184
putris, 132-139, 172, 175-177, 182, 185, 198
sanctaehelenae, 185
sanibelensis, 171, 175
semiserica, 154
spurca, 163
stretchiana, 171, 175
strubelli, 135, 171
urbana, 135, 171, 175
vaginacontorta, 183
Succineidae, 25, 26, 131-201
Succineinae, 131, 169, 171, 193, 195, 197, 198
Succinella, 184, 195
oblonga, 184
Succineoidea, 178
Succinoides, 132, 182, 188, 193, 194
stelliferus, 182, 188
sulcata, Isognomon, 8-10, 15
Tectarius, 8, 12, 13
grandinatus, 8, 12, 13
Tellina, 4, 15
robusta, 15
rugosa, 4, 15
scobinata, 4, 15
Tellinidae, 15
Teredo, 207
texana, Catinella, 135, 170
texana, Quickella, 171
tigerina, Codakia, 9, 15
tigris schilderiana, Cypraea, 50
Tornatellinidae, 177
Trapeziidae, 15
Trapezium, 8, 15
oblongum, 8, 15
Triboniophorus, 25, 26
graeffei, 25, 26
Tridacna, 5, 7, 15
maxima, 5, 15
Tridacnidae, 15
Triviacea, 51
trivolvis, Helisoma, 21-24
Trochidae, 14
Trochoidea, 121-126
seetzeni, 121-126
Trochus, 8, 14
calcaratus, 8, 14
tropicus, Bulinus, 27
Truella, 184, 195
truncata, Lambis, 8, 14
truncata, Truncilla, 127, 128
Truncilla, 127-129
donaciformis, 129
truncata, 127, 128
tumida, Lithotis, 189
Turbinidae, 14
Turbo, 8, 12, 14
setosus, 8, 12, 14
Umbraculidae, 14
Umbraculum, 9, 14
undosus, Cantharus, 8, 12, 14
unguis, Omalonyx, 177
Unionidae, 127
urbana, Succinea, 135, 171, 175
vagans, Catinella, 190
vagans, Quickella, 161, 171
vaginacontorta, Succinea, 183
Vanikoridae, 14
Vanikoro, 8, 14
petitiana, 8, 14
Veneridae, 15
Venus, 4, 8, 15
reticulata, 4, 8, 15
vermeta, Catinella, 132, 133, 135, 159-163, 170, 171, 190
vermeta, Quickella, 159
Vermetidae, 7, 14
Vermetus, 5-9, 12-14
maximus, 5-9, 12-14
Veronicella, 177
Veronicellidae, 178
versicolor, Columbella, 8, 14
Virgiconus, 14
flavidus, 14
Virroconus, 14
chaldaeus, 14
coronatus, 14
ebraeus, 14
lividus, 14
miliaris, 14
sponsalis, 14
volutata, Limnea, 210
volutata, Lymnaea, 210
washingtona, Xylophaga, 207
Xerocrassa, 121
seetzeni, 121
Xylophaga, 207
washingtona, 207
Zoila, 50
schilderi, 50

NOTICE TO CONTRIBUTORS

Upon acceptance for publication in *MALACOLOGICAL REVIEW*, all manuscripts, including plates, maps, diagrams and all copyrights thereof become the property of the journal and are subject to the editorial policy of the editors. The editors reserve the right to make literary and other amendments as are deemed appropriate to improve the scholarship of the papers, and to make amendments to plates, maps and diagrams in order to bring them into conformance with policies and style of the journal. A reasonable number of text figures and plates will be reproduced at no cost to the author, but they should be assembled in good taste and according to the standards of *MALACOLOGICAL REVIEW*.

MALACOLOGICAL REVIEW

MALACOLOGICAL REVIEW is published as a scientific periodical and may contain review articles on various aspects of malacology, experimental and descriptive papers on molluska, opinion on current publications, malacological announcements of special interest, etc. *MALACOLOGICAL REVIEW* is affiliated with the following malacological publications:

American Malacological Union Bulletin
Argamon
Bulletin
Communicaciones de la Sociedad Malacológica del Uruguay
Conchiglie
La Conchiglia
The Echo
Johnsonia
Journal of the Malacological Society of Australia
Malacologia
Malakologische Abhandlungen, staatliches Museum für Tierkunde in Dresden
Occasional Papers on Molluska
Stylommatophora
Venus

MALACOLOGICAL REVIEW is affiliated with the following malacological organizations:

Association belge de Malacologie, de Conchyliologie et de Paléontologie
Malacological Society of Australia
Malacological Society of Japan
Nederlandse Malacologische Vereniging
Sociedad Malacológica del Uruguay
Società Malacologica Italiana
Society for Experimental and Descriptive Malacology
The Israel Malacological Society
Unione Malacologica Italiana
Unitas Malacologica Europaea
Western Society of Malacologists

MALACOLOGICAL REVIEW subscription prices per year (postpaid) for institutions and addresses for ordering are given below:

US$ 8.00

MALACOLOGICAL REVIEW
P. O. Box 801
Shelmare Lake
Michigan 49104
U. S. A.

$A 7.15

MALAYOLOGICAL REVIEW
c/o Australian Museum
6-8 College Street
P. O. Box A285
Sydney South, Australia

¥ 2560

MALACOLOGICAL REVIEW
c/o Mukaishima Marine Biological Station
Onomichi P. O.
Hiroshima-ken, Japan

£ £ 3.5

MALACOLOGICAL REVIEW
c/o Department of Zoology
Ain Shams University
Abbassia, Cairo
U. A. R.

Rs. 80.00

MALACOLOGICAL REVIEW
c/o Marine Biological Station
of Annamalai University
Porto Novo, Tamilnadu
India

Subscription price for private individuals in North America is US$ 5.00, and for non-North American private subscribers slightly higher to defray postage costs (A$ 4.90, Rs. 42.00, ¥ 1780, £ £ 2.5).